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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Thirty-sixth Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
SECRETARY'S OFFICE, 26 CENTRAL SQUARE,
EAST BOSTON, MASS., January 8, 1906.

The 36th Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Tuesday and Wednesday, February 20th and 21st, 1906. The usual number of papers are in course of preparation and, with numerous questions sent in for discussion, the time of the meeting promises to be fully occupied. Members will please note the change from the usual days, on account of Thursday being a holiday. Detailed information regarding the programme, etc., will be mailed to members before the meeting, so that each may come prepared to do his full share, and make the meeting more successful than its predecessors. N. W. GIFFORD, Secretary.

[NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF THE WRINKLE DEPT.,
719 CITIZENS BUILDING,
CLEVELAND, O., June 13, 1905.

The Wrinkle Department of the Ohio Gas Light Association is now ready to receive contributions for the 1906 collection, and a sketch or description of all devices, formulæ and methods of accomplishing objects pertaining to the gas business, is respectfully solicited.

Please send a written explanation, accompanied by any sketch, photograph or drawing, to the above address, or a description alone will suffice.

Hoping to receive prompt compliance,

Yours very truly. W. E. STEINWEDELL, Editor.

BRIEFLY TOLD.

AWARD OF THE FRITZ MEDAL.—The second award of the John Fritz Medal has been made to Mr. George Westinghouse. This medal was established by the professional associates and friends of John Fritz, of Bethlehem, Pa., August 21, 1902, his 80th birthday, to perpetuate the memory of his achievements in industrial progress. The award was made by the following Board selected for the purpose: From the membership of the American Society of Civil Engineers: Messrs. Alfred Noble, Chas. Warren Hunt, Chas. Hermany, C. C. Schneider. From the membership of the American Institute of Mining Engineers: Messrs. James Douglas, Charles Kirchhoff, E. E. Olcott, E. G. Spilsbury. From the membership of the American Society of Mechanical Engineers: Messrs. Robert W. Hunt, S. T. Wellman, James M. Dodge, John E. Sweet. From the membership of the American Institute of Electrical Engineers: Messrs. Charles P. Steinmetz, Charles F. Scott, B. J. Arnold, John W. Lieb, Jr. The medal, which is of gold, of a value of about $100, is accompanied by a certificate of the award, and was awarded to Mr. George Westinghouse for "The Invention and Development of the Air Brake."

SMITHSONIAN

"Gas, Gasoline and Oil Engines," by Mr. Gardner D. Hiscox.—The 15th edition, revised and enlarged, of this well-known work, which has been before the public for some years, has just been issued. It contains 351 illustrations and 442 pages, each one of which is instructive and interesting. Only about 40 pages are devoted to the theory of explosive and internal combustion engines, and among them we regret to notice several errors which will confuse and perplex the student. On page 23 the statement is made that gas expands $\frac{1}{273}$ of its volume for each degree C. of increase in temperature. This, of course, applies only to gases that are at zero C., and at no other temperature, and it should be so stated. On page 31 the statement is made that explosive mixtures of pure gases, as hydrogen and oxygen or carbonic oxide and oxygen, suffer a contraction of $\frac{1}{3}$ their volume by combustion of their compounds to steam or carbonic acid. This is only true of the gases mentioned, and not as a general statement, as simple or elementary gases combining in equal volumes, as carbonic oxide do so generally without contraction of the combined volume of the constituents. Constructive details of the various engines and appliances treated of are very clearly and intelligently described. The assertion on page 366 that the Diesel engine may be fully as frictionless as a steam engine, and that an indicated horse power hour requires only 6,000 B T.U., is rather astounding, in view of the small progress made in the introduction of the engine in this country. An interesting list of patents, and of manufacturers of gas, gasoline and oil engines in the United States, is appended. We think the book well worth its price ($2.50 net), but it cannot be considered as a classic in the wide field it attempts to cover. It is printed by the Henly Publishing Company, of this city.

Notes—

Mr. J. A. Mayers, who has just returned from a trip to the West Indies, informs us that he celebrates his return by receiving from the Queens Borough Gas and Electric Company, of Rockaway, L. I., a contract for the installation of a set of purifiers and a water gas washer. Of course the work is to be done by the Gas Machinery Company, of Cleveland.

Mr. T. H. Labryn, Resident Manager of the Cheboygan (Mich.) Gas Light Company writes under date of the 22d inst. that he observes there was a mistake in our issue for the 15th inst.; and thus corrects it: "I did not succeed Mr. Richard Schaddelee as Manager of the Albion, (Mich.) plant, but I did succeed him as Manager of the plant at Cheboygan, Mich.

Mr. John Lennihan, of Quincy, Mass., has been appointed Superintendent of the plant of the Marlboro-Hudson (Mass.) Gas Company, vice Mr. R. P. Sharp, whose duties were completed in Marlboro when the construction of the Hudson line was completed.

The Duluth (Minn.) authorities are in the market for a gasholder up to retaining 500,000 cubic feet.

Mr. John Cabot, writing to the Journal under date of the 24th inst., says: "* * * Let me say that the tray business was excellent last year, our sales having been so much in advance of expectation that we have again had to increase our plant, now occupying 9 city lots. The prospects for the coming season are good, and we have on hand many large orders, among them the full quota of trays for the Consolidated Gas Company's plant at Astoria, N. Y., this order covering over 75,000 square feet; orders for an outfit for the Buffalo (N. Y.) Company, the Springfield (Mass.) Gas Light Company, and the San Antonio (Tex.) Gas Light Company, which shows that our favors come from wholly separated localities."

At the annual meeting of the Laclede Gas Light Company, of St. Louis, Mo., it was shown by the annual reports that the percentage increase in gas sales over the prior twelvemonth amounted to 5.05 per cent., and the gross earnings show an increase in the gas sales' division amounting for the like comparison period of 4.5 per cent. The electric division of the Company's business was not so prosperous. There was no change of moment made in the executive management.

A correspondent in Omaha, Kas., forwards the following under recent date: "The Omaha Gas Company recently paid into the city treasury $18,776.98 as its franchise royalty for 1905. The amount is the largest in 12 years, or since the Company began to pay the city 5 cents for every 1,000 feet of gas sold private consumers. It is $1,651.38 greater than last year, $6,833.84 more than in 1900 and $11,366 more than 10 years ago. The sworn statement filed by Vice-President and Secretary Clabaugh shows in 1905 the Company sold 401,580,451 feet of gas for all purposes, and for the 13 months beginning December 1, 1904, 418,090,979, exclusive of that used by the city. Deducting December, 1905, for which collections were made in January, 42,551,289 feet, the amount of gas on which the royalty was paid is 375,539,690 feet."

Increased Use of Gas in the Industries.

By "Traveller."

The boot and shoe "shining" parlors, the hat cleaning and polishing establishments and the singeing of textiles have introduced methods of employment of gas for different mechanical operations in connection with their respective lines of work. It is no longer the bootblack of the busy thoroughfares of the city and town who monopolizes the shoe polishing business; it is the shoe polishing magnate, with his decorated polishing parlor and his up-to-date equipment of devices for the comfort and accommodation of patrons. Considerable sums of money are earned in these modern shoe and hat polishing institutions. You can find a cashier and bookkeeping department in connection therewith. With this progress in the mechanical portion of the hat and shoe polishing work much new and improved apparatus has been introduced, including some illuminating gas devices; in fact, common house gas forms one of the important factors in the industry in its present stage of development. Let us look into some of these "palatial polishing places." Here you will find a well adjusted plate glass front. No one is out front calling attention of passers by to the shoe polishing, because that would be beneath the dignity of the parlor, although a few signs are put out designating the character of the business.

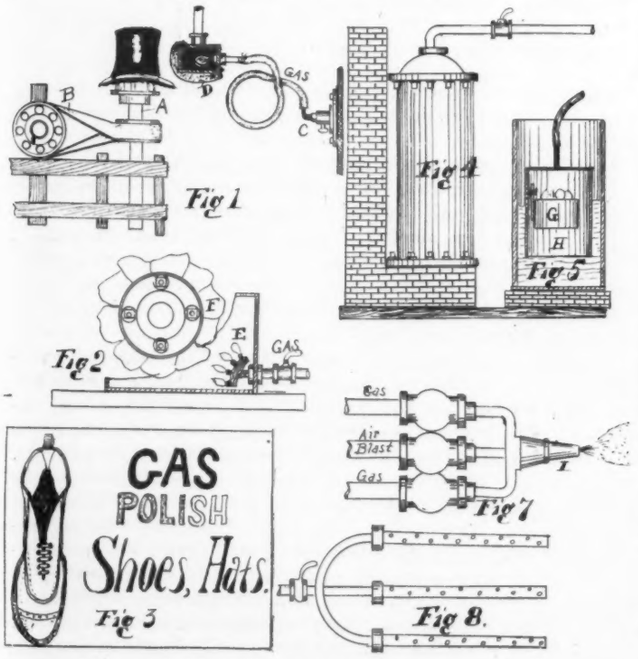
You pass inside and observe a row of plush covered chairs, some of which are occupied by persons whose shoes are in process of polishing or whose hat is being attended to. You notice pipes extended from wall tubes carrying gas to certain devices. In the really first-class institutions there are means for connecting the rubber tubes to plugs fitted to supply pipes; but in some of the parlors we notice that the supply of gas is drawn direct from gas jets. This is a simple way, but is not practicable under all conditions, as the supply of gas is restricted to the capacity of the burner. However, we will observe the nature of the hat polishing arrangement presented in Fig. 1. I found many places in which considerable business was done in polishing hats by the gas method. The wood frame device carries the wheel and belt *B*, for turning the upright spindle *A*. The spindle is fitted with the necessary block to carry the hat as shown. The wheel *B* is revolved by hand crank, or by motive power secured from a belt running from a shaft overhead. The gas burner is fitted with a rubber tube *C*, and through this tube the gas passes to the polishing contrivance *D*, which contrivance consists of a metal frame device, about twice the size of a common flat iron, hollowed so as to admit the burner and flame as shown; thus the metal block is always kept heated.

The metal block is padded on the polishing side, and ample heat impregnates the padding to make the polishing surfaces warm. The padding is a felt cover, packed with hair. The hat is speedily revolved and the gas heated polishing device is applied by hand until the required gloss is obtained. Fig. 2 illustrates one of the handy, soft-cloth polishing wheels, in which the cloth is warmed by the little gas jets at *E*. In order to get the desired results without charring the wool fabric, *F*, of the wheel, the wheel is first set to revolving at the rate of about 110 turns per minute. At this speed the heat of the jets does not have much chance to ignite the fabric; the heat penetrates into the fiber. Thus a warm textile fabric surfacing is obtained for application to the surfaces of the hat.

Fig. 3 is a drawing of one of the signs put out by one of the shoe and hat polishing parlors in which gas is used as the agency for glossing. In almost every instance the gas is drawn from the supply of gas furnished for the building for lighting purposes. In some few instances, however, I found that home-made gas was used. This rather complicates matters, usually makes a mess in the shop, and sometimes results in accidents. The cheaper method will always appeal, no doubt, and for this reason we will always find more or less of the shop-made gas in service.

In one case I noticed that a retaining tank for carbide gas was used, which tank was arranged on a masonry foundation as shown in Fig. 4. The gas had to be compressed in the cylinder. Acetylene gas is a first rate gas for use, if you can control it well. For instance, in one polishing shop they had an arrangement by which the carbide gas used manufactured itself only as consumed. This is apparently quite safe, as there is never enough gas accumulated to do much damage, even if an explosion occurs; but you will have to be careful with the compressed acetylene gas in the cylinder. Keep it in a separate apartment, in the back yard if possible. Improved systems are being introduced so that much of the danger is eliminated. In fact I do not know of any explosion having occurred except, as the result of carelessness, in which case any other kind of gas would have acted similarly. The

device for making the acetylene gas from carbide as needed is shown in Fig. 5. There is an inner inverted cylinder *H*, shown in section in the cut, which cylinder fits inside the larger one. The latter is filled with water half way up. The carbide is placed in a metal cup *G*, and this cup is supported to a hook inside the inner cylinder as shown. As soon as the carbide touches the water the gas forms. The gases fill the chamber and then pass off through the tube at the top to the point of use. The cylinder rises and falls according to the amount of gas made, so that only enough gas is in the reservoir to keep up the supply. Hence there is never gas enough ahead to make much of an explosion, even if one happened. I find that illuminating gas is also used in shoe and hat polishing parlors for purposes of singeing. Many hats are made over new while you are getting your shoes polished by a system of singeing and polishing. The tall hat, and often the felt hat, is shabby in appearance because of the presence of loose, nappy fibers. These fibers are simply scorched off in the singeing process. Fig. 7 shows one form of gas singeing flame. The hat is revolved at

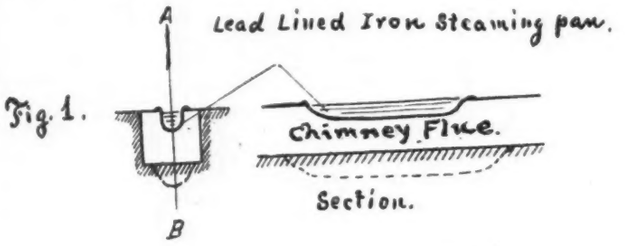


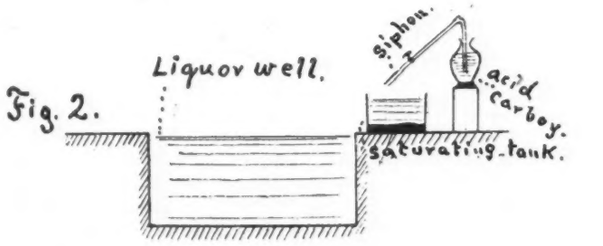
great speed just near enough the flame *I* to char off the felty fibers. Sometimes the singeing outfit is arranged with a series of jets by having 3 pipes with holes for serial burners. After the singeing of the surfaces of the hats, the latter are put through the usual finishing processes and many of them are made over quite new for 5 or 10 cents before the last touch is put on your shoes.

[Prepared for the JOURNAL by MR. F. EGNER.]

Treating the Waste Ammoniacal Liquor at Small Gas Works.

This is the subject of two short articles by Dr. E. Ott, Chemist to the City Gas Works at Zurich, Switzerland, printed in the *Journal für Gasbeleuchtung* of recent dates. Dr. Ott remarks that to realize anything, or to even render harmless the gas liquor produced, frequently presents the greatest difficulties to small gas works, because neither shipping it away nor working it up by the distillation process would pay; and there is not always a large enough water course conveniently near which would take up without harm to fisheries this otherwise so valuable by-product. Therefore, to obviate all disagreeable consequences, he recommends that this gas liquor should be rendered harmless by neutralizing it with a cheap acid, and points out that doing so might result in a source of revenue as well, instead of its being only an otherwise unavoidable nuisance. For acids he recommonds the cheapest kind of sulphuric, or hydrochloric (muriatic) acid, stating that, even if the salt produced is not very clear as to color, such salt has been employed for a long time past in the manufacture of sal ammoniac, and for which purpose it would find a ready market, though it would also do well enough for agricultural purposes. The following are his recommendations as to the practical operations to carry out his suggestion—giving the sense if not the words *verbatim* used by Dr. Ott: There should be provided a wooden saturating tank, located near the liquor well, and a boiling or steaming vat made of iron and lined with lead, which should be located where any waste heat—of which there is a plenty at all gas works—can most conveniently be applied. The chimney flue of the retort bench would be in such a place where the steaming vat could be built in, as may be seen in Fig. 1. Fig. 2 indi-





cates the relative position of the liquor well, saturating tank and acid carboy, and shows also how the acid may be run into the saturating vat by use of a siphon and valve attached. The operation may be conducted by any ordinary, intelligent laborer, and calls for no more scientific appliance than the use of litmus paper or methyl orange.

To preserve the steaming vat as much as possible it will be best to make the saturated liquor slightly alkaline; that is, to let the ammonia predominate a little over the acid. The operation will be to partly fill the saturating tank with liquor, and then run the acid in slowly, vigorously stirring the contents of the tank with a wooden rod at the same time, until blue litmus paper will begin to turn red. Then add a little more of the liquor until reddened litmus paper will just begin to again turn blue. The quantity of ammonia thus lost will be very slight, while the danger of greater loss by not having enough acid in the mixture will be eliminated in the first place, and it will be a very safe method of working if ordinary labor must be employed. The sulphuretted hydrogen escaping during the neutralization will be such an inconsiderable quantity that, as the operation may be conducted in the open air, it may be neglected altogether; but if desired a hood may be fixed over the tank, and the vapors arising can be conducted under a couvenient grate or into a chimney and thus rendered inoffensive. The steaming vat should be built in such a manner that it could be easily taken out for sometimes necessary repairs; also, if it has been set into the chimney flue, because there will be times when no salt will be made—that is, when the operations would be interrupted for one reason or another. The liquor conveyed from the saturating tank into the steaming vat or pan is not entirely evaporated in the latter, but only down to the point when a a crystallizing skin begins to show. The liquor is then run into a wooden crystallizing pan conveniently located, and the salt crystals are fished out with a wooden ladle and deposited on a drying table. The remaining mother liquor may be used again by repumping into the scrubber along with the other liquor in the liquor well. Dr. Ott remarks he regrets to say that, as he does not know of this process having been worked in everyday practice at any gas works, he cannot give actual facts as to cost, etc., but he offers the following theoretical calculations with results: Let us suppose a gas works producing annually 100 cbm. of gas liquor (corresponding to the consumption of about 600 tons of gas coals), which would contain 1.5 per cent. half-fixed ammonia (about 2° Beaume), or 1,500 kg. NH_3. [*Note.*—A part of the ammonia is "fixed," which, of course will only be advantageous since less acid to neutralize will be required.]

To convert this ammonia into sulphate, 4,500 kg. of 66° sulphuric acid would be needed, resulting in 5,820 kg. sulphate. The yellow sulphate obtained in the local laboratory by means of operating as described contained, when dry is 20.6 per cent. nitrogen. A sample of dark, gray sulphate sent in later contained 2.4 per cent. water and 20.3 per cent. nitrogen after drying, so that at the present time it could easily be sold for about 30 francs per 100 kg. to chemical works or

agricultural associations, which would represent receipts equal to 1,746 francs. The concentrated acid will hardly cost a gas works more than 10 francs per 100 kg., including freight, which would be an expenditure of 450 francs.

Cost of labor cannot come to much, as the work could easily be done incidentally by one man, but assuming 300 francs for that object, there will remain 1,746 — (450 + 300) = 996 francs. From this must be taken the amounts due interest and amortization on cost of plant, which will come to about 500 francs, assuming that two steaming vats of iron, lined with heavy lead and each of 200 liters capacity would cost 300 francs, and the cost of setting them 200 francs. Should one also include something on account of removing the sulphuretted hydrogen there will still remain a considerable net profit. This would be even greater if instead of sulphuric, hydrochloric acid should be used; 1,500 kg. NH, require 3,220 kg. HCL, and yield 4,720 kg. chloride of ammonia; 100 kg. 20° hydrochloric acid (of about 32 per cent.) would cost, freight included, at most 7 francs, so that 3,220 kg. HCL, equal to about 10,000 kg. of 20 per cent. hydrochloric acid, would come to 700 francs.

The price of the chloride of ammonia, figured at 50 francs per 100 kg. would produce an income of 47.20 × 50 — 700 = 1,660 francs instead of 1,296 francs as in the case with sulphate. The result might be still higher if reasonably fair waste acids could be obtained.

The only difficulty which the writer observes in this matter to begin with would appear the amount of ammonia assumed to be contained in this very much attenuated gas liquor quoted from the Doctor's figures. But there are advantages in this very simple process which readers in control of small gas works would do well to consider. For re-pumping the water used in the scrubber is entirely practicable, and in that way a reasonably strong liquor might be obtained, making the balance of the operation worth while.

But even aside from that, Dr. Ott's suggestion is not without value for the class of works mentioned by him, as the writer knows from a recent experience, when the running into a small stream of otherwise clear gas liquor was seriously objected to because of the smell, and a shutting down the works in consequence was threatened, whereas following Dr. Ott's suggestion the liquor would be disposed of not only without any kick coming from dissatisfied neighbors, but with an actual profit of anywhere from $100 to $150 per year.

Flueless Gas Stoves and Their Effects on the Atmosphere of Rooms.

By "E. D. W.," in *Journal of Gas Lighting.*

A surprising development in the use of gas for heating purposes has been the rapid extension during the last few years of the number of condensing or flueless gas stoves. These stoves, made originally in small sizes and with luminous burners, were then recommended only for use in well ventilated positions; but their descendants of the present day, although enormously increased both in their actual dimensions and as to the gas consumption, and frequently fitted with a bunsen burner heating hollow fuel to incandescence as in an ordinary gas fire, are now being fixed in positions in which there is no specially free ventilation—such as offices, schools, waiting rooms, etc. Made now in a great variety of patterns and sizes, and with the fire itself visible or inclosed, they seem to get over the difficulty of warming those rooms which cannot conveniently be fitted with an outlet for the products of the combustion of the heating agent. There can, in fact, be but one objection to their use—viz., that the combustion of gas produces carbonic acid and water vapor; and the former of these is not usually considered a desirable constituent of the atmosphere, from a hygienic point of view.

It becomes necessary, therefore, to investigate the objection due to the presence of carbonic acid gas in the air of the heated room; and this can best be effected by noting the actual quantity of carbonic acid produced by the combustion of a given volume of gas. For the purpose of this argument, the average composition of coal gas will be sufficiently accurate if taken thus:

Hydrogen	50 per cent.
Light carburetted hydrogen	36 "
Unsaturated hydrocarbons, olefiant gas, etc.	4 "
Carbonic oxide	6 "
Nitrogen, etc.	4 "

The combustion of 100 cubic feet of this gas will be found to require about 115 cubic feet of oxygen, or (say) 575 cubic feet of air; the products of the combustion being (say), 50 cubic feet of carbonic acid and a quantity of water vapor, which, being mostly condensed, can be passed over for the present.

From these figures it will readily be seen that, with a stove consuming 20 cubic feet of gas per hour, 10 cubic feet of carbonic acid are being added to the atmosphere and 23 cubic feet of oxygen used hourly. There will thus be an actual loss of pressure in the atmosphere of the room due to the replacement of 23 cubic feet of oxygen by only 10 cubic feet of carbonic acid. [It is, of course, assumed that the whole of the water vapor formed by the combustion is condensed.] This difference of 13 cubic feet will be filled by that quantity of air from the outside, ⅕ of which (or 2.6 cubic feet) will be oxygen. If, now, it is assumed that there is no ventilation in the room in which the stove is fixed, except that induced by a slight vacuum as explained above, and if it is further assumed that the dimensions of such a room are 20 feet by 20 feet by 10 feet, or 4,000 cubic feet, the use of the condensing stove will involve the following alterations in the composition of its atmosphere:

	Nitrogen.	Oxygen.	Carbonic Acid.
When stove is lighted	3,200 cu. ft.	800 cu. ft.	
After 1 hour's use	3,210 "	780 "	10 cu. ft.
After 2 hour's use	3,220 "	760 "	20 "

And so on; the atmosphere losing 20 cubic feet of oxygen for every hour, and gaining 10 cubic feet of nitrogen and 10 cubic feet of carbonic acid.

As a matter of fact, it would be quite impossible to find a room so utterly without ventilation as that imagined above. Rooms fortunately have to be furnished with doors, and mostly with windows; and there is sure to be a certain amount of accidental ventilation from these. Moreover, if the room has a boarded floor, there will be spaces between the boards; and the ventilation through these is of a particularly useful description, as the high specific gravity of the carbonic acid will make it tend to fall through.

The loss of oxygen stated above amounts to 0.5 per cent. per hour—that is, the oxygen starting at 20 per cent. of the total atmosphere is reduced to 19.5 per cent. at the end of the first hour, *if there is no ventilation.* It will, however, be apparent from the figures given, that a room ventilated by an ordinary allowance of doors and windows, especially if the former are opened frequently, is not likely to have its atmosphere seriously vitiated by a condensing gas fire. It will be noticed also that it is assumed that the whole of the water vapor is condensed. This will be the case when the air of the room becomes saturated with water vapor, though a portion will issue from the stove as vapor; and, unless there is sufficient ventilation to carry it away, will condense in the room, preferring the coldest surfaces, such as windows.

Another factor which has a strong bearing on the subject is that a portion of the carbonic acid formed by the combustion is taken up by the water as it condenses and runs down the tubes of the stove. The quantity of carbonic acid thus absorbed will doubtless vary considerably under different conditions—the length of tube which has to be traversed by the products of combustion being the principal factor. It is always considerable, and is therefore a strong point in favor of the condensing stove. The sulphur compounds in the gas will also be taken up by the condensed water being burnt to sulphur dioxide in the flame, which gas, on coming into contact with the water in the tubes, forms sulphurous acid, which again is oxidized to sulphuric acid on exposure to the air.

It will thus be seen that the only product of combustion which really affects the atmosphere is a portion of the carbonic acid. There is an unreasonable prejudice existing in the lay mind against this gas—it is commonly spoken of as "poisonous;" and it is, of course, quite true that it is the principal constituent of the "choke damp" of wells, etc., and the "after damp" of coal mines. As a matter of fact, its chief offence against animal life is that it is not oxygen, and that its presence usually (though not necessarily) means that the percentage of oxygen present in an atmosphere is diminished. Carbonic acid is, in fact, a poison of the negative, or passive, description; and although an animal in an atmosphere of pure carbonic acid would die in a very short time, it must always be remembered that the same thing would happen with pure nitrogen. It is, therefore a mistake to value an atmosphere by the percentage of carbonic acid present; the really vital consideration is the percentage of oxygen. In confirmation of this view of the harmlessness of carbonic acid, it may be well to mention that the deaths in coal mines caused by "after damp," which used to be attributed to carbonic acid, have been shown to be due to carbon monoxide, which is also present in the "after damp," though in a very small proportion to the carbonic acid.

A consideration of the nature and quantities of the products of com-

bustion which are likely to pass into the atmosphere from a condensing or flueless gas stove will, therefore, lead us to the conclusion that there can be no risk to health in the great majority of the positions in which they are fixed. In fact, it would be simpler to mention the few conditions which render the use of flueless stoves inadvisable, than to enumerate the many circumstances under which they are quite innocuous, as far as vitiation of the atmosphere is concerned, and more efficient than any stove fitted with a flue, in heating effect per cubic foot of gas used. The conditions to be avoided then, are, firstly, any obviously badly ventilated room, particularly if, in addition to the stove, artificial light has to be used during the daytime; secondly, any room with a large number of occupants relative to its cubical contents, unless there is some good and absolutely certain method of ventilation; and, thirdly, a dwelling room occupied by perhaps few people, but these likely to remain in the room for comparatively long periods and without much ingress and egress. Here, again, the objection need not hold good if there is an efficient ventilating system.

Referring to the second condition under which it is contended to be inadvisable to fix a flueless stove, it must be remembered that each human being produces, on an average, about 0.75 cubic foot of carbonic acid per hour. So that if a large number of people are at work in a factory with a limited number of cubic feet of space to the individual, there already exists a percentage of carbonic acid in the atmosphere, to which it would be unwise to add. When it is further pointed out that, with the carbonic acid given off from the human frame, there also come germs and *débris*, both from the lungs and the skin, it will readily be agreed that what is required is an addition to the ventilating power, and, consequently, a stove with a flue is indicated.

Of the flueless gas stoves, those fitted with bunsen or atmospheric burners are undoubtedly better than those in which the gas burns with a luminous flame; for in the latter case there is always some risk of a small quantity of carbonic oxide appearing among the products of combustion, owing to the latter being incomplete. Even an infinitesimal percentage of this gas in the atmosphere is a serious matter and it is always as well, therefore, to use a bunsen burner, in which the copious air supply makes its production a practical impossibility. Whichever pattern of burner is employed, it should be fitted with a governor, to prevent the consumption varying with alterations of pressure on the district.

It is probable that, with their extended use, there will be considerable improvements in flueless gas stoves in the near future. Among these will perhaps be some method of taking up chemically—say by lime—a larger portion of the carbonic acid produced. This could probably be best effected in the tubes. But as the stoves are made at present, a little caustic potash added to the condensed water in the pan will have considerable effect, and at very trifling cost. This, however, necessitates the use of an earthenware or vitreous enamelled pan. If something of this sort were carried out, it would greatly help to reduce the prejudice which still exists in many minds against anything "flueless;" and full advantage could then be taken of the increased heating effect per cubic foot of gas obtained by these stoves.

The Annual Meeting of the Mueller Mfg. Company's "Travellers."

In accordance with its annual custom the H. Mueller Manufacturing Company had its traveling salesmen in off the road for a 10 days' conference and school of instruction the first of the year. The meeting was held at the home office of the Company at Decatur, Ills., and all of the 20 salesmen and the officers of the Company were in attendance. The purpose of the gathering was to thoroughly inform the men in the details of the business that might be to their advantage in selling goods. Incidentally the visit of the salesmen was made pleasant by a number of social features, among them being the annual banquet by the Company to the salesmen in the large dining room at the office, and the dinner to the officers of the Company and their wives at one of the local hotels The names of the traveling men, their "pictures" and their headquarters for the present year are: From Decatur office: Mon. T. Whitney, 5912 Normal avenue, Chicago, Ills.; W. B. Ford, P. O. Box 749, Birmingham, Ala.; Francis C. O'Neill, 711 Maine street, Quincy, Ills.; W. N. Dill, Pacific Coast representative; Horace F. Clark, 15 Waverly Place, Grand Rapids, Mich.; D. E. Rowley, 219 Bright street, Indianapolis, Ind.; F. J. Murphy, 4543A McMillin avenue, St. Louis, Mo.; W. C. Heinrichs, 1336 Byron avenue, Chicago, Ills.; Murry F. Kirkwood, 1330 Prospect avenue, Kansas City, Mo.; J. H. McCormick, Huron, O.; F. B. Mueller, Decatur, Ills.; James Smith, 725 Bellefonte

street, Pittsburgh, Pa.; H. E. Paxton, Decatur, Ills. New York office: W. D. Malane, 2216 St. John's Place, Brooklyn, N. Y.; Arthur C. Pilcher, P. O. Box 865, Springfield, Mass; J. W. Pine, 197 Main street, Rochester, N. Y.; Charles Tillinghast, Woodland avenue, Woodhaven, L. I.; C. T. Ford, 821 16th street, N. W., Washington, D. C.; George A. Caldwell, 808 Blue Hill avenue, Boston, Mass.; W. F. McCarthy, 5013 Larchwood avenue, Philadelphia, Pa.

Power Required to Thread, Twist and Split Wrought Iron and Mild Steel Pipe.

[From a paper read before the last meeting of the American Society of Heating and Ventilating Engineers, by MR. I. N. THOMSON.]

Some time ago my attention was called by the National Tube Company to steps that it is taking along the line of inducing manufacturers of dies to make certain improvements in the form of the dies that will enable the fitters to cut better threads with a smaller expenditure of energy than obtains at present with the ordinary forms of dies. I have investigated the matter a little from an educational standpoint on behalf of the International Correspondence Schools of Scranton, with a view to imparting reliable instruction to our students, many of whom are located in out of the way places, and even in foreign lands.

There are two kinds of steel pipe and two kinds of wrought iron pipe on the market—namely, good wrought iron and poor wrought iron, good steel and poor steel—and you cannot ordinarily distinguish between them till after the goods are bought and the men are cutting and threading them on the job. Some will split, some will chip as if made of crystal, in some the threads will strip, while others may even break across like glass bars. At the same time the trade must have very good uniform dies, and very good uniform pipe. If they cannot both be obtained at once, then let us get one at a time.

Tests of Pipe Rings.—I made a tour of some of the largest pipe mills in America. I carefully followed the process of making the wrought iron pipe from the puddling furnaces and the steel pipe from the blast furnaces, all through the mills, to the shipping department. The rolling, welding, straightening, threading, testing and shipping processes are exactly the same for wrought iron as for steel pipe, the only difference being in the composition and properties of the two metals. To all external appearance they are the same. I had a number of ring tests made to show the peculiarities of the two metals and the relative strength of wrought iron and steel pipe. It was a noticeable fact that the wrought iron rings broke very easily under the straightening out process by which a combination of tensile and cross strains are developed.

Fig. 1 shows at *a* how the test was applied. A ring of pipe about 1 inch to 1½ inches wide is secured by two hooks in a testing machine. The machine is set in operation and the hooks are pulled apart until the ring breaks, the pull applied to the ring by the machine being indicated by an electric measuring device. The rings tested were cut from lap-welded pipe; the welds in the tests were placed as at *a*, Fig. 1, so as to test out the weld with relation to the strength of the other parts of the pipe. The illustration shows at *b* how the mild steel rings generally broke and at *c* how the wrought iron rings frequently broke. The tests developed the fact that some of the welds were stronger than the pipe, while others were weaker than the pipe. The strength of the weld depends a great deal upon the amount of the lap; those that did break at the weld were apparently short laps.

Table No. 1 shows the result of some tests I had made on 8 rings of

6-inch pipe, 4 being wrought iron and 4 being mild steel. I made these principally to observe the ductility of the metals in pipe form and the fractures, but the results are nevertheless interesting.

TABLE I.—*Ring Test—Lap Weld Pipe.*

Wrought Iron. Actual Breaking Strength.	Mild Steel. Actual Breaking Streng h.
4,100 pounds.	5,300 pounds, defective weld.
3,100 pounds.	35,000 pounds.
3,000 pounds.	29,000 pounds.
2,400 pounds.	18,000 pounds, hooks slipped.

Tests were also made by the National Tube Company which showed the tensile strength of the metal, the tensile strength of the seam and the relative strength of the seams as compared with their respective pipes. Perhaps the most important feature of these tests, as far as we are concerned at the present moment, is the fact that the ratio of strength between seam and pipe varies considerably. The strongest iron seam is 84 26 per cent. the strength of the pipe; the weakest iron seam is 49.07 per cent. the strength of the pipe. The strongest steel seam is 92.96 per cent. the strength of the pipe, and the weakest steel seam is 50.30 per cent. the strength of the pipe. No doubt these were samples of good pipe. The results, therefore, serve to emphasize the fact that neither wrought iron pipe nor steel pipe is uniform throughout in character and strength. It particularly shows how some pipes will split more easily than others while being worked.

The plumbing and heating trades experience a great deal of trouble with pipe; the seams frequently become split while the pipes are being threaded, and considerable loss of time and money is occasioned all around. The reason why the seams become split is because they are not as strong as the rest of the pipe. If they were as strong as the pipe, then it would appear that the pipe would either twist or tear when an excessive force tends to open the seams.

Thread Cutting Dies.—Most of the splits in the trade are produced, I believe, in threading butt welded pipes. The lap welded pipes evidently do not split so frequently. The teeth of the dies in cutting the thread at the butt weld seem to catch squarely against the weld as shown in Fig. 2, which exaggerates the thickness of the pipe, but clearly shows by arrows the direction of the principal forces that tend to split the pipe at the seam. The cutting face *a* of the die is radial—that is, it points toward the center of the pipe. The cutting edge, therefore, is a right angle. This kind of die, I understand, is to-day used more or less by nearly every firm in the heating business. I call this an imperfect design, because it does not have an acute angle cutting edge like any other cutting tool.

All tool manufacturers know that there is a certain angle or rake that is best adapted for cutting different metals in the most easy and most perfect manner, but it seems that the die makers are very slow in methodically introducing this principle into the die business. Fig. 3 shows at *a* the tearing out process of metal cutting by the imperfect dies in common use, and at *b* the correct principle of cutting metal as it is recognized by expert metal workers.

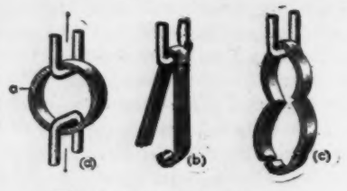


Fig. 1.—Tests of Pipe Rings.

Fig. 2.—Action of Ordinary Die.

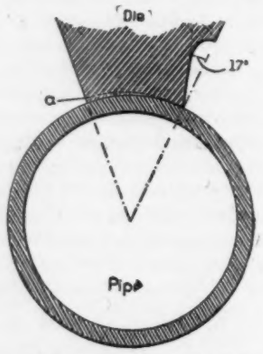


Fig. 3.—Die Made with a Rake.

Suppose *a a*¹ to be plates of mild steel such as is commonly used in pipe manufacture, then according to tests that have been made, the power required to pull the cutter *b* is about 60 per cent. more than that required to pull the cutter *b*¹; and if a relief is made on cutter *b*¹, as shown by dotted line *c*¹, the difference will be more near 100 per cent. If the plates were made of wrought iron, the power required to pull *b* would be approximately 45 per cent. more than would be required to pull *b*¹. The ratio of powers, of course, will vary with the composition and physical properties of the metals, but for ordinary wrought iron and mild steel, as they are found in pipe form, the aforesaid ratios, I believe, are approximately correct.

A large number of experiments on different forms of dies, the cutting rake, etc., go to show that the best angle of rake for dies that are to be used only on wrought iron pipes is about 12°: the best angle of rake for dies to thread only mild steel pipes is about 20°, and the best angle for a die that is suitable for both wrought iron and mild steel pipes is about 17°, as shown in Fig. 3, and it can be greatly improved by having the die cut with a relief, as shown by dotted line *a*, so that the die will bear on the pipe only at the cutting edge.

Fig. 4 shows how the power was measured for threading both wrought iron and mild steel pipe with both the square edge die and the improved die. A test made on this machine with two samples of good pipe gave the results shown in Table 2. The dies were both in good condition; it is from this trial that the preceding ratios are determined:

TABLE II.—*Tests of Dies.*

Kind of Pipe.	Old Form of Die. Pull in Pounds on a 21-Inch Lever.	New Fo m of Die. Pull in Pounds on a 21-Inch Lever.
1¼-inch wrought iron.	83 to 87 pounds pull.	58 to 62 pounds.
1¼-inch mild steel.	100 to 111 pounds pull.	60 to 65 pounds.

The samples used in the test were ordinary good quality pipe picked out at random. It shows that the power required to thread mild steel pipe with the new die is not much more than that required to thread wrought iron pipe with the same die, and much less than the power required to thread wrought iron pipe with the common die.

This is an improvement in dies that makes the threading operation very easy on the men. If men are to be expected to do good work and keep it up all needless expenditure of energy should be eliminated. I do not see the use of a fitter pulling 100 pounds on a stock arm if a pull of 60 pounds can be made to accomplish the same purpose. An objection may be raised to the effect that if a pipe is so poor that it will split while being threaded it has no right tp be installed as part of a heating or power system. This objection is strictly correct, but it is no reason why we should depend on testing pipes for splitting proclivities by cutting threads on them.

The fact of the matter is that all the pipes should be tested at the mills and all imperfect pipes should be cut up and sent to the scrap pile. A number of the large mills test all the pipe that is shipped, every pipe threading machine being equipped with a corresponding measuring and testing machine and a trained crew, but I do not know whether all pipe mills are thus equipped.

Twisting as a Test for Pipe.—To depend on the threading process for testing pipe seams is, in my estimation, absolute foolishness, for a large amount of pipe is fitted up in every job that never is subjected to the twisting strain produced by threading. For example, a number of full lengths constitute part of the mains; they are threaded in machines at the pipe mills by properly made dies. The risers are constituted principally of pipes that have a short piece cut off one end and the end threaded. The only piece that has been subject to twist is the short part that came between the vise and the die. The remainder of the length has had no twist except a little at the other end that may be applied by the Stillson in screwing up the pipe. Of course it is advisable to take all precautions to prevent poor pipe from getting into a heating or power system, but it seems to me that better results will be obtained by an intelligent inspection of the seams and by a series of torsion tests that will actually test the strength of the welds the full length of the pipes. Of course, the right place to have pipes tested is the place where they are made. It, therefore, seems to me that torsion tests should be applied at the mills. Probably the present hydraulic testing machines can be slightly changed so that each pipe while being tested with water pressure will in the same operation be subjected to a certain amount of twist that will immediately prove whether the pipe is water tight and whether it will split in being handled by the trade.

To secure some definite information regarding the power required to split or twist pipe a number of torsion tests were very kindly made by the National Tube Company. The sizes twisted were ½, ¾ and 1 inch. The pipes were selected at random. I purchased a lot of common

merchant pipe on the open market by cutting a piece out of a length in different bundles. No two pieces were taken from the same length nor from the same bundle. In this way I believe we obtained a fair average. Each sample to be twisted was 6 feet long. Fig. 5 shows the machine used to make the test. One end of the pipe was secured to the chuck of a lathe, the other was secured to a clamp having a 3 foot lever, which was held up by a spring balance as shown. The machine was put in motion and the power required to twist the pipes or split them was recorded on the spring balance and noted. Each piece of pipe was subject to precisely the same conditions. The results of the tests were tabulated in detail and are altogether too voluminous to be incorporated in this paper.

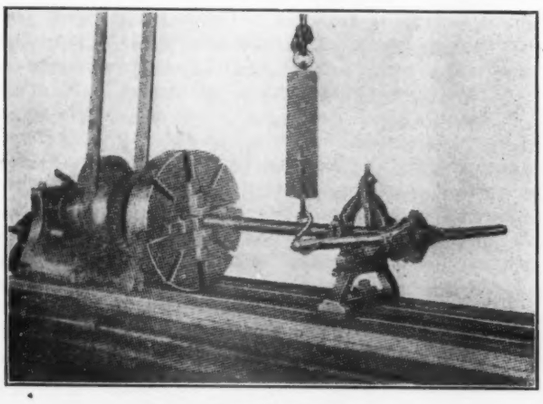


Fig. 4.—Rigged for Threading Pipe.

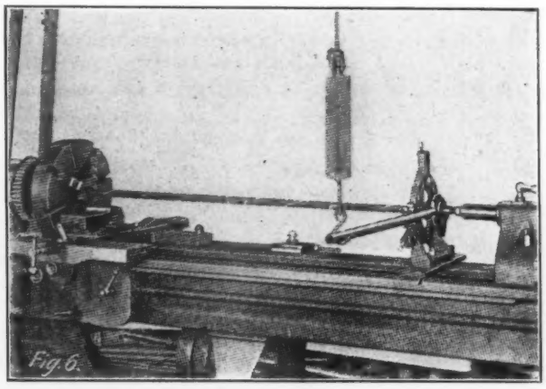


Fig. 5.—Rigged for Twisting Pipe.

Machines for Measuring Power to Thread and Twist Pipe.

TABLE III.—*Twisting Tests on Butt Welded Pipe.*

Inch.	Material.	Weight per Foot. Pounds.	Maximum Pull on 3-Foot Lever Pounds. Low.	High.	Average.	No. of Turns in 6 Feet.	Per Cent Failed in Welding
⅛	Steel	0.816	90	120	109	15	0
⅛	Iron	0.803	40	98	68½	4½	73
⅛	"	0.792	20	113	81	5¾	66
⅛	"	0.842	50	85	65	2½	100
¼	Steel	1.082	160	185	172	8	13
¼	Iron	1.097	140	160	154	6.2	33
¼	"	1.127	80	176	136	3½	66
¼	"	1.104	50	160	107	2½	90
1	Steel	1.658	180	340	300	5½	13
1	Iron	1.593	220	292	256	4½	46
1	"	1.616	170	300	250	3½	33
1	"	1.620	100	320	258	2½	66

Table No. 3 is simply a summary of a large number of detail tables. In making up the latter tables the record of every piece of pipe is noted separately. As the photos of the twisted pipes are too numerous to be all presented in this paper, I have selected the steel samples and the middle iron samples of each size. It would not be fair to put up the last line of samples of iron pipe against the steel photos, because this iron pipe was very poorly welded, as can be seen by Table 3, and a false impression of wrought iron pipe may be formed.

Power for Threading Measured by Hand.—The tests of the National Tube Company I am satisfied are very thorough and are exceedingly valuable records, but as they were all made on machines, and as ¼, ¾ and 1-inch pipes are threaded by hand in pipe vises, I made a number of tests at the laboratory of the International Correspondence Schools with a view of obtaining as nearly as possible the strains that are actually placed on pipes in practice. We secured a number of samples from different supply houses and from the racks in the plumbers' and fitters' shops in Scranton, the idea being to test the regular nondescript merchant pipe in common use and find how much power is actually required to thread and split this class of pipe by the mechanics on the jobs. To make the threads we borrowed the tools from the trade, so that there also we would get actual practical results. In making the tests we used a pipe vise and Stillson wrenches, so that the action of their teeth and the shifting of grips would all form a part of the tests. Of course it must be expected that tests made this way will develop entirely different results from tests made in machines with properly designed clamps and a steady application of the power. While the International Correspondence Schools tests give an idea of what takes place at the pipe vise with hand tools, the National Tube Company tests show what may be expected at the threading machine.

Fig. 7 shows how we rigged up the apparatus. Two rigid 2 × 8-inch uprights each having 3 holes bored through, as shown, one being for 1-inch pipe, one for ¾-inch pipe and the other for ½-inch pipe. The pipe in all cases was grasped by a vise which was bolted to the center by a 4 × 4-inch timber. The pipe was lubricated where it passed through the uprights. As the arms of the stocks were 18 inches long from the center of the dye to the extreme end, and the actual distance of the center of a man's hand will be about 2 inches from the end of the stock arm, we attached an eye bolt to the 4" × 4-inch timber so that the hook of the spring balance would be 16 inches from the center of the pipe in the vise. In this way we can read on the spring balance the amount of pull a fitter has to apply to the dies. For convenience the power required to twist and split is also given with the balance at a 16-inch lever.

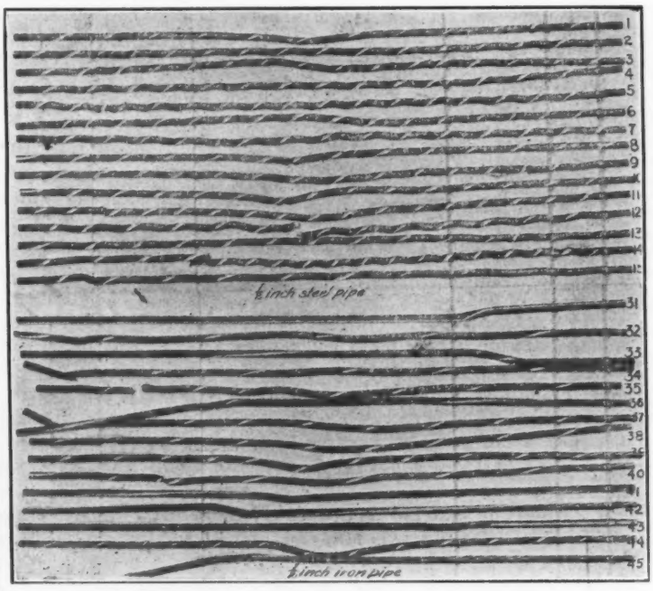


Fig. 6.—View of the Pipes After Having Been Twisted.

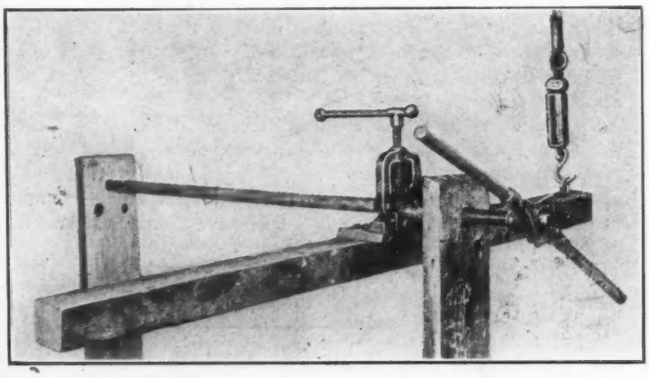


Fig. 7.—Apparatus for Measuring Power for Pipe Threading by Hand.

The difference between the threading operation, which is shown in Fig. 7, and the twisting operation is that in the latter the dies were removed, Stillson wrenches were applied to the other end of the pipe

where it passes through the upright, and the pipe was twisted by these wrenches. Of course the wrenches chewed into the pipe and so did the vise, but this is a true condition of the trade and it is well for us to know what happens under such conditions. The records were all taken during steady pulling. When the dies were pulled quickly in jerks or run dry the power increased anywhere from 30 to 50 per cent. The old common form of dies referred to was in very fair condition, the 1-inch die being particularly good. It did not cut down to gauge, and its record consequently is rather low. A summary of the results of the tests is given in Table IV.

In making the torsion tests, we had to screw up the vise tightly to prevent the pipe turning and this tended to crush the pipe and start the seam. Most of the splits started at the vise. Galvanized pipes were more difficult to hold than black pipes.

TABLE IV.—*Approximate Power Required (Pounds) to Thread, Twist and Split Pipe.—Summary.*

	To Thread: Well Oiled: Steady Pull at 16-inch Leverage on Die Stock Arm.		To Twist.	To Split.	
Kind of Pipe.	New Rake Dies. Pounds.	New Common Dies. Pounds.	Old Common Dies. Pounds.	Steady Pull With Stillson's. Pounds.	Steady Pull With Stillson's Pounds.	Margin of Safety. Pounds.
¼-inch steel. (4 samples)	34.5	56.25	60.5	122.5	152.5	73.85
¼-inch iron. (7 samples)	27.14	33.14	49.14	102.14	110	46.12
½-inch steel. (4 samples)	44.25	60.5	90.75	150	240	122.05
½-inch iron. (8 samples)	44.375	51.25	73.5	140	176.43	80.88
1-inch steel. (5 samples)	68.8	111	124	273	420	258.8
1-inch iron. (7 samples)	62.14	105.7	118.57	272.85	226.66	172.52

The margin of safety column at the right hand side of Table 4 is compiled by adding 30 per cent. to the power required to thread with old dies and subtracting the sum from the power required to split the pipe. If the dull mechanic pulls on the dies beyond that limit, due to dull and imperfect dies, or due to a hard spot in the pipe, he certainly will, according to the nature of things, split the pipe. Or, if the power required to split is nearly the same as the power required to thread, as is the case in the last sample of ½-inch pipe in the mild steel list (which, on test, proved to be ½-inch galvanized iron) then the pipe will certainly split through no fault of the mechanic, but through defective tools combined with a quick, jerky motion which the men must put on the dies if they are going to hustle along the work. With dies having the proper rake there would be no danger of splitting this pipe while welding it.

It is noticeable that the margin of safety for the steel pipe is much greater than for the wrought iron pipe, and it seems rational to assume that the trade must experience trouble by wrought iron pipe splitting at the vise as well as steel pipe. Judging by the tests, it is evident that common steel merchant pipe will ordinarily twist before it splits and that common wrought iron merchant pipe will sometimes do the same thing, but the iron will not twist as much as the steel and requires on an average less power both to split and twist. However, in wrought iron this weakness is somewhat compensated for by the smaller amount of power required to thread.

My opinion of the entire case independent of all outside influences, is that correctly made dies are a step in the right direction, and that die makers should make all their dies with a rake that is best adopted for threading both wrought iron and mild steel pipes, and with sufficient relief to reduce friction. I would suggest for your consideration the preparation of a standard torsional test that any intelligent mechanic can easily and quickly apply on a job to any length of butt-welded pipe, with the object of determining whether or not the weld is sufficiently strong to warrant its use in a building.

The American Cement Industry.

The great English engineering authority, *Engineering*, writing on this subject says: Although we have become so accustomed to the rapid growth of special industries in the United States that we are apt to pay little heed to statistics published with regard to them, yet the careful study of these statistics is often very interesting, more particularly when the industries in question are directly connected with the engineering profession. Many of these special industries could, of course, be named. It is to one of them—the cement industry—that our attention has particularly been drawn by information published, among contributions to economic geology, by the department of the United States Geological Survey. The figures there given show great advances. Only a very few years ago the output of cement in the United States was quite insignificant. In fact, there hardly was any output at all, and nearly the whole of the cement used in public works and similar undertakings came from abroad. Now the case is different, and the country itself supplies a very large proportion of the cement it uses. If we consider only the years from 1900 to 1903, the advance has been rapid. In 1900 the value of the three classes of cement—Portland, Natural and Puzzolana—manufactured in the United States was $13,283,581; in 1903 it was $31,931,341, or an increase in 3 years of about 140 per cent. Nearly the whole of this increase was in Portland cement, for, although the output of Puzzolana (slag) cement rose during the 3 years from $274,208 to $542,502, or about 100 per cent., the total amount manufactured was so small in comparison to Portland cement that it has not much influence on the value of the total output. The value of natural c ment turned out in the same time rose from $3,728,848 to $3,765,520—a totally insignificant increase.

It will be seen from the preceding figures that the position held by Portland cement as an industrial product is vastly superior to that occupied by either the natural product or slag cement. This is as one would expect, for the uses to which both the natural and the slag cement can be put are limited when compared with Portland cement. For many purposes, of course, the natural cements are well adapted, and their manufacture is comparatively simple. They can be produced by burning in a kiln similar to an ordinary lime kiln, using a naturally impure limestone, containing silica, alumina, and iron oxide, and the burning is done at a comparatively low temperature. The process drives off nearly the whole of the carbon dioxide in the limestone, the lime combining with the silica, alumina and iron oxide to form a mass containing silicates, aluminates, and ferrites of iron. Should magnesium carbonate be present in the limestone, the cement formed will contain a corresponding amount of magnesia. The mass as it comes from the kiln will not slake in water, and it is therefore necessary to grind it. The powder, when mixed with water, hardens rapidly, and the hardening will take place under water; in other words, it is hydraulic cement.

As is well known, Portland cement differs in many ways from natural cement. In the first place, it is produced in quite a different way, by a method much more complex and exact; and, secondly, its characteristics are more important. Moreover, Portland cement is a definite product, its percentages of lime, silica, alumina and iron oxide varying between narrow limits, while brands of natural cements vary greatly in composition. The temperature at which Portland cement is burned is much higher than that required for natural cement, the temperature necessary for the former being somewhere near 3,000° F., while for the latter it may never approach the fusing or clinkering point. Portland cements are heavier than natural cements; they also set slower, and attain a higher tensile strength. In many ways the composition of the two is similar, though in the case of one its constituent parts are of lime, silica, alumina, and iron oxide, artificially mixed in certain definite proportions, while in the other they are burned in the state in which they are found in nature.

In the Puzzolana cements the required properties are made by mixing powdered slaked lime with either volcanic ash or blast furnace slag, the product being simply a mechanical mixture, which is not burned at any stage of its menufacture. The Puzzolana cements are more suitable for setting under water than in air.

Among the States of the Union, as a producer of Portland cement, Pennsylvania takes the lead. In 1903 it turned out 9,754,313 barrels of cement, having a value of $11,205,892. The State of New Jersey was second, with an output of $2,693,281 barrels, worth $2,944,604. In the year 1890 there were in the whole of the United States only sixteen Portland cement producing plants, whose output was 335,500 barrels, valued at $439,050, while in 1903 seventy one plants were at work, with the output previously stated. Of these total amounts for the whole of the States, 60 per cent. was, in the year 1890, manufactured in the Lehigh district of Pennsylvania, while 55.1 per cent. of the total was turned out there in 1903, showing that the other States are now supplying a rather greater proportion of the total output than they were in 1890.

The typical American practice in the manufacture of Portland cement from dry materials may be said to owe its present success very largely to the works of the Lehigh district, for, before the manufacture of Portland cement in Pennsylvania was commenced, the dry process was not looked upon with favor, owing to the fact that in this process stationary kilns could not well be used. In the early plants, therefore, water was liberally used, but, with the introduction of rotary kilns, the dry process was adopted, as is the usual practice in the Lehigh

district. The cement rock is first crushed and dried, the former operation being generally performed in large gyratory crushers, and the latter mostly in rotary dryers. The necessary amount of crushed and dried limestone is then added, and the materials mixed, and again further reduced together. The next step commonly taken is to pass the mixture to ball mills, though other mills are sometimes used. The materials are ground to a fineness usually not exceeding 85 per cent., through a 100-mesh sieve. This compared with the practice at plants using limestone clay mixtures, is coarse work, but it is not so harmful as might be expected, owing to the fact that the mixture is mostly made up of cement rock, which is naturally well mixed. Before being fed to the rotary kilns the materials are slightly damped.

Lime, silica, alumina and iron, the essential elements that enter into the composition of Portland cement, are to be found widely distributed in nature. Theoretically, therefore, we may say that a satisfactory Portland cement mixture may be prepared by combining these materials in many ways and in varying proportions. At one end of the scale there would be the natural rock of absolutely correct composition; at the other, two or more materials, in nearly equal amounts, would be required. The great number of raw materials, theoretically available are, however, soon reduced to a very few under existing commercial conditions. Many of them are ruled out of consideration by the question of cost, though their chemical composition may be suitable. Again, some materials, though quite suitable, may be difficult to get or hard to break up. So it happens that comparatively few combinations of raw materials are actually used in practice, and we find that a Portland cement mixture when ready for burning usually consists of about 75 per cent. of carbonate of lime, 20 per cent. of silica, alumina and iron oxide together, with a remaining 5 per cent. of magnesium carbonate, sulphur and alkalies that may be present. In the United States the various combinations of raw materials at present used in the manufacture of Portland cement may be grouped under the following heads: (1) Argillaceous limestone (cement rock) and pure limestone; (2) pure hard limestone and clay, or shale; (3) soft, chalky limestone and clay; (4) marl and clay; (5) alkali waste and clay; (6) slag and limestone.

In 1898 the total production in the United States of Portland cement from "cement rock" and pure limestone was 2,682,304 barrels, and in 1903 it had risen to 12,483,694 barrels; that made from hard limestone and clay, from 315,608 barrels to 6,338,520 barrels; the marl and clay cement from 545,372 barrels to 3,052,946 barrels; while chalk and clay accounted for 39,000 barrels in 1898, and 457,813 barrels in 1903. In the figures belonging to hard limestone and clay, however, the product from two plants using slag and limestone is included, and in the figures under the heading "marl and clay" there is the product of one plant using alkali waste and clay.

In the natural cement manufactured in the United States a clayey limestone is invariably used, which has from 13 to 40 per cent. of clayey matter, from 10 to 22 per cent. of silica, and from 4 to 16 per cent. of alumina and iron oxide. The presence of magnesium carbonate in a natural rock is regarded as merely incidental where, for natural cements at least, it takes the place of lime, as far as the hydraulic properties of the product are concerned. The 30 per cent. or so of magnesium carbonate found in the cement rock of the Rosendale district of New York could, for instance, be replaced with an equal amount of carbonate of lime, and the result would still be an hydraulic product.

The burning of the materials for natural cement is usually done in vertical kilns, the limestone and fuel being fed into the kilns in alternate layers, though in a few plants more advanced methods are adapted. The product when burned is reduced to powder, for the most part in buhrstone mills, though some tube mills are now used. Limestone sufficiently clayey for the manufacture of natural cement is found in almost every State of the Union.

Coming to Puzzolana cements, the materials used in the manufacture of these are either natural volcanic products, such as puzzolana, trass, or basic slag from the blast furnaces. We believe, however, that natural puzzolanic materials have never been used in America, although they exist in various districts in the West. The slag cement manufactured is obtained by the pulverization, without calcination, of a mixture of granulated blast furnace slag and slaked lime. It is said that this article is often marked as "Portland cement," although it differs in composition and properties. If this be true, the practice can only be regarded as most reprehensible.

As to the composition of slag cement, it has been stated by Tetmajer that the ratio $\frac{CaO}{SiO_2}$ should never be less than unity, and that the best results are obtained when the ratio $\frac{Al_2O_3}{SiO_2}$ give a value of 0.45 to 0.5, though Prost and Mahon claim to have obtained good results from slags in which the alumina was much higher than this.

A point to which attention has been called with regard to these slag cements is that the slag from which they are manufactured should be cooled as suddenly as possible, which can be done by bringing it in contact, as it issues from the furnace, with a stream of cold water. This treatment breaks up the slag into porous particles, and, if it is of suitable chemical composition, renders it strongly hydraulic. It also removes most of the sulphur in the form of hydrogen disulphide. The lime used in cement of this kind should be low in magnesia, well burned, and carefully slaked. The proportions of slag and lime used in the American plants are from 100 parts of slag to from 20 to 40 parts of lime. The mixture and final reduction are generally carried out in tube mills.

These slag cements are lower in specific gravity and lighter in color than Portland cements; normally they set more slowly, though this can be overcome by treatment during manufacture. They do not very well resist mechanical wear, and in dry situations they do not set in a satisfactory manner. Under water, or in permanently damp situations, they are, however, useful.

Electric Wiring in Indiana.

In a report just made by Mr. Frank Daniel, Electrical Inspector for the Indiana State Board of Underwriters, he cites examples of his inspection of 20 or more of the principal cities of Indiana, and from what he discovered the electrical conditions are in imperative need of improvement. Mr. Daniel says the low standard of equipment is due to lack of knowledge and skill on the part of electrical workers. In many instances he found the chief fault was due to honest intentioned but unskilled workmen, to whom the National Electrical Code is unknown. The poor conditions are the outgrowth of a haphazard development marked by inharmonious additions and patchwork. In rare cases only have the electrical systems for lighting and power in the cities of Indiana had the advantage of intelligent direction from the start. Mr. Daniel said he found many cases of wiring that are the work of men or boys equipped only with nippers and a screwdriver and a desire to become electricians. As a result there are many cases of wiring and electrical installation that are truly "fearfully and wonderfully made." Mr. Daniel, who is an electrical inspector of a technical college education backed by years of experience as an electrical engineer, in his report says:

"I was dumfounded by the many hazardous conditions discovered and often wonder how these faulty systems continue to distribute chained lightning to its appointed tasks with only an occasional outbreak on the part of the mysterious force."

Mr. Daniel says that large sums of money will, of necessity, be expended in Indiana in electrical betterments. Mr. Daniel cited cases where he found wooden rosettes strung like incendiary beads on a run of 80 feet of weatherproof wire which was supported by winding around iron gas cap outlets. This wire was pieced out at the feeding end with 3 feet of lamp cord which had a maximum capacity of 2 amperes. This piecing could not have been done safely with anything less than No. 8 wire which had a capacity of 33 amperes, and the lamps should have been in regulation rosettes. In the same store he found in the cashier's office and under a counter a busy fire-spitting motor. The floor under it was thick with grease and pieces of paper were ready to get busy with the first spark that should happen to fall. By all the rules of the game this store should have burned out at least 10 times a day.

"I took a wooden fuse box from a millinery store. It controlled the main line carrying all lights in the store. There were 50 of these and the sole protection was the single-pole fuse there shown. All wiring was supported on wooden cleats. Wood rosettes were used and wood base stretcher. The whole equipment was blissfully in violation of the National Code," said he.

Mr. Daniel said the Badger furniture store fire in Indianapolis last month was of electrical origin and emphasizes a number of points for which professional inspectors are contending. Here a 5-horse power motor was installed in a house on the roof directly over the elevator shaft. Some sort of fault existed in the motor which caused the fuse to burn out. Instead of finding the fault and remedying it, the man in charge of the motor finally got tired of replacing fuses, and to make himself less trouble put in a fuse large enough to carry the objecting

current. This did the work and saved the man further annoyance, but the irritation in the motor coils of mechanism continued, causing the current to seek another avenue of escape. It finally found a weak place in the wire connecting field and armature coils and here it broke bounds and grounded. The sparks resulting fell on the oily floor under the motor and started the fire.

A recent fire in Terre Haute was started from a home-made rheostat, the arm of which was controlled by a rope passing over a window sash, the pulley of which moved the contact arm. The rheostat was constructed of small pieces of broom wire spliced together, the whole being supported in direct contact with a frame partition. Mr. Daniel closes his report by saying that competent electricians are needed. Conditions in Indiana show conclusively that most of the defects in wiring are due to ignorance on the part of local workmen. There is need for more technical knowledge among the electrical inspectors and workmen to bring conditions up to a standard.

Mixing Concrete.[1]

By Mr. J. H. Robinson.

Concrete mixing in batch machines is sometimes condemned. Continuous mixing is also sometimes condemned by engineers who have obtained better results by the batch method. Yet each of these methods of mechanical mixing has its use or application in places where the other might be inappropriate.

In hand mixing one of the great temptations is to use concrete that is too wet. Such a mixture depends upon the fluidity of its matrix rather than upon its thorough incorporation, and the result is generally work that cannot be characterized by any other word than "botched."

An example of the extent to which too wet concrete may be used is furnished by a firm of contractors (who wished to produce a job remarkable for its cheapness rather than its excellence) in the instructions to the superintendent. He was ordered to make the concrete "so wet that it would not stand any ramming other than that produced by the feet of the men who were laying it." This meant that the men must work knee-deep in a mushy, muddy mass, that had so much water in it that without ramming 6 or 8 inches of clear water rose to the top of footing courses only 30 inches thick. This is radically different from flushing the surface by proper ramming. Ramming gives a solid mass, compacted by pressure; the other method gives a loose, almost spongy, sedimentary deposit that is neither compact nor workmanlike.

The ease with which wet concrete may be placed and "flowed" into the various parts of the forms, without ramming, tempts the contractor and sometimes the engineer to use a too wet mixture. Wet concrete is a good thing, but it should not be wetter than enough to make the mass quake like liver under hard ramming, which flushes the surface. Dry concrete is also a good thing, but it should not be so dry that the water will not flush under hard ramming.

Machine-mixed concrete is, perhaps, better for wet mixtures, when made by a continuous mixer; and for dry mixtures, when made by a batch mixer.

The uniformity of the product depends more upon the care with which the measuring is done, rather than upon the type of mixer; though this last has also a noteworthy effect.

One reason for the preference shown for very wet concrete by some contractors is the fact that, with mixtures of this character, it is easy to conceal botchy work. A common practice in such cases is the use of a flattened shovel, which is shoved up and down along the inside edge of the forms as the concrete is placed. This is often all the ramming that such concrete gets; it is too wet; and the very fact that a shovel may be introduced and kept in motion to the extent it is done is proof of a too wet or too thin mixture. The appearance of the resulting structure is good, the finished surface of the concrete is smooth and the corners are sharp. But the interior! Let the engineer break into and examine one mass of concrete that has been laid in this manner. He will be apt thereafter to insist upon dry concrete; for however much more trouble it may be, when thoroughly mixed dry concrete is rammed until the water flushes to the surface, it is proof positive of good work.

And yet dry concrete if not properly mixed is apt to produce as botched a job as the wet, only the dry concrete shows the imperfections on the surface, aod one is not lulled into a false sense of security by the fine appearance of the outside.

In batch machines the theoretically correct manner of mixing can be carried out rather better than in any other form of machine. The sand and cement can be thoroughly mixed dry, then mixed wet, and finally may have the wet aggregate added and mixed. This procedure may be followed to the extent that, under careful management, results may be obtained in ordinary practice that are otherwise unattainable. This, of course, requires that the proper amount of water be used. Too much water is as bad as, if not worse, than too little.

Mixing conctete by haud is economically done when sufficient room is available and the nature of the work will permit, by arranging a long mixing board in such position that the one end may be at the point where the material is delivered, and the other at the point nearest the structure to be erected. The cement and sand are mixed dry and the stone, after wetting, shoveled into the mixed mass and the whole then sprinkled and turned. It is in turning that the utility of this form of mixing board becomes apparent; the mass is turned to the sides in fan-like manner and then to the center, following always the general direction toward the place where the concrete is to be laid. This procedure will save largely in the amount of handling required, as the more times (within reasonable limits) the concrete is turned the better the mixture, a more truly homogenous mass is obtained, as well as dispensing largely with shoveling into barrows and wheeling.

This method, of course, may be applied where the sequence of mixing the various ingredients is not that given; it is the principle of doing away with extra handling and not its method that it is desired to point out. The particular method given is especially useful in foundations or other work on one level, but it may be applied in many other ways.

1, *Engineering and Mining Journal.*

The Limitation of High Pressure Gas Transmission.

By Mr. W. H. Y. Webber, in *Gas World.*

The question of the advantage of the adoption of pressures greatly superior to anything ordinarily used in the transmission and distribution of illuminating gas is one that, to my mind, does not admit of a general answer. I am moved to make this observation by Mr. Walter Hole's valuable articles on the subject in the *Gas World*, and by the instructive paper on the high pressure side of the question read by Mr. H. L. Rice before the last meeting of the American Gas Light Association. I may as well confess, at the outset of these remarks, that my position in regard to the question has been always that of awaiting the proofs in the case whenever a claim has been preferred for the superiority of the principle of high pressure gas transmission. That is to say, my mental attitude in this regard has been one of strict reserve, which I have endeavored to keep as free from prejudice on one side as from being imposed upon by any fanciful attractions on the other. For although such a subject as this might, on the face of it, be deemed rooted in the hardest matter-of-fact, and as far as possible from lending itself to "sentiment" or becoming the "fancy," yet experience of engineers, as well as of engineering, warns one that not infrequently the personal equation is far and away the most potent in indicating how certain problems will be treated in particular hands. This aberration is specially to be looked for in connection with new developments of old problems of practice. Just as some engineers will always do their work in a routine style, regarding new-fangled ways and means with habitual mistrust, so others are of quite the opposite temperament and achieve what in their estimation is personal distinction if they can proclaim themselves as, say, "high pressure men," or what not. There is, in short, much more human nature in engineering than the nature of the profession would appear to afford room for; and the gas branch is certainly no exception to this rule.

It is getting into a good many years since the first "high pressure man," in the engaging individuality of Mr. Shelton, the well-known American engineer, rose upon the flat horizon of gas distributing practice. The thing, of course, existed before. As Mr. Rice records in the beginning of his paper, power driving of illuminating gas through trunk mains has been practised for getting Beckton gas to London for 30 years, and there were isolated examples of it in different parts of England. But there was no idea of fastening the classification of "principle" upon these everyday operations. The engineers concerned simply raised their working pressure or head as they wanted more gas. But in no case did they go beyond an initial pressure which remained comparatively low as contrasted with steam pipe pressures. I will return to this point presently. Meanwhile, a totally different order of technic was being formed in connection with the piping of petroleum and petroleum (natural) gas in the United States. Quite naturally, American gas engineers had an eye upon these high pressure pipe lines, and eventually copied them. There was no physical difficulty in the way. The natural gas man pioneered the enterprise, so that when in the fullness of time Mr. Shelton stepped forth as the prophet of a new dispensation in gas supply, he and his followers could simply go ahead and take possession of this Land of Promise has apparently proved to

be an "Oklahoma rush." Mr. Rice informs us that high pressure work to-day stands "solely on its own merits, an established factor in gas engineering."

The Economy.—It is claimed for it that it saves capital in bulk transmission, whether to district gasholders or for direct consumption off the main, owing to the relative smallness of the pipes permitted by the system; and also that it is a cheap means of reinforcing ordinary district main pressures. Obviously, if, as Mr. Rice says, a 2-inch high pressure main will answer as well as a 6-inch low pressure main, and have a reserve margin of supplying power as well, here is a possibility of saving in main laying. But evidently there are limits to this economy and it is not to be had for nothing. It is not all saving. It looks at its very best in the case of running a supply to a small village off the trunk line, with 150 consumers or thereabouts, not likely to be too particular. The bigger the scheme of distribution, however, the more the advantages of the system are eaten into by troublesome precautions and other considerations. The nature of many of these sets-off are revealed by Mr. Rice. Compression, even to 5 pounds above the atmosphere, to which limit blowers are available, costs anything up to 1½d. per 1,000 cubic feet (Forstall). "No satisfactory method of measuring the gas delivered by compressors has yet been reported." There is some condensation and loss of illuminating power, but this is not serious. If there is any likelihood of the maximum draught upon the pipe line overtaking its delivering capacity, something by way of a district gasholder has to be provided. The pressure reducing regulators must be in duplicate. There is no saving in the services. The saving on the capital sunk in mains is reckoned at two-thirds of the cost of the ordinary low pressure cast iron mains; and that is the whole of it. Against this must be set the cost of compression, including the risk of breakdown, which calls for duplicate machinery.

It need not surprise one to learn that, except for "boosting" purposes, this high pressure system of gas main working is not yet favored in large American towns "where the cost of street main investment is of relatively less moment and danger from sudden leakage of much greater concern." That is to say, the idea—with the exception of boosting, as aforesaid—has not grown to the proportions of anything much more important than a 6-inch works. Discussing the paper, Mr. Forstall pointed out where the economic limit of high pressure transmission lies, and showed that "when the assumed consumption was over 2,000,000 cubic feet per mile it is cheaper to distribute by low pressure." This puts the system on a very much lower grade of utility than the noise made about it would lead one to expect.

Returning now to the question of the gain in delivering power of gas mains from increase of pressure. It has been remarked that the Beckton to London transmission pressures have not been carried beyond about 2 pounds above the atmosphere. Why is this? I have no special knowledge of this matter; but will hazard the suggestion that it is probably because the distributing engineers of the Gas Light and Coke Company, from the late Mr. R. Harris to Mr. G. F. L. Foulger, hold by the old rule that, as Mr. Rice puts it, "delivery increases only with the square root of the pressure"—the importance of which he fully admits. Pressure here means head or driving power. The expression then becomes as Mr. Hole quotes it from Newbigging, Cripps, and others: The discharge varies as the square root of the (driving) pressure. Also, friction is supposed to vary as the square root of the velocity. Put these two elements together, and one very easily arrives at an understanding, in respect to any particular example, of when the working maximum delivery is reached.

The New Formulæ.—But, as Mr. Rice remarks, although if we are to hold by these old formulæ we might be quickly discouraged from seeking after any advantage from high pressure, there is "a way round," which has been kindly found by several later computers who have built up formulæ for high pressure deliveries "of radically different structure as to indicated pressure effect." Far be it from so poor a mathematician as myself to impugn the validity of these exercises; but it nevertheless appears to me that while of the making of such formulæ there is no end, they cannot upset the laws of gravity and the viscosity of gases upon which Dr. Pole's formula is based. The question is, do the new conditions contain anything competent to vitiate these accepted rules? Mr. Hole remarks on this point that the degree of compression may disturb a formula designed for use under far different circumstances. Why, if it remains true that the hydrostatic pressure has nothing to do with the delivery of the pipe? I notice, by the way, that hardly one of the American examples of high pressure "distribution" is so really. There is high pressure at both ends of the pipe, which contradicts the assumption that the delivery is according to the initial pressure. For, plainly, if the initial pressure is maintained at 50 pounds and the other end pressure at 45 pounds, it is just the same as if the initial pressure was 5 pounds, and the delivery at atmospheric pressure. Whatever the cost of getting up this extra high pressure, it is therefore waste.

Mr. Hole proceeds to mention, as another new factor, the expansion going on in the pipe, assuming that the initial pressure is 20 pounds and the end pressure 1 pound. Truly, this gas is doing work in expanding; but it can never restore the amount of work done upon it in compression, which has to be paid for. Not that the return is in the same form as the expenditure, of course; but has Mr. Hole realized what friction this degree of expansion in the pipe means? It appears to me that unless the gas can be imagined to have dropped its viscosity, the friction resulting will make the high pressure formulæ look very remarkable indeed.

Is there no other new condition to be considered? Then let us proceed to hear what the new computers teach Mr. Rice. He says, "In examining the character of this formula (which he gives) it is at once seen that as the initial pressure becomes relatively large compared with the final pressure, the amount delivered increases more and more in exac ratio with the pressure." So he logically goes on to calculate that merely by raising the initial gauge pressure at one end of a mile of 4-inch pipe from 5 pounds to 300 pounds, the quantity of gas delivered will be increased from 20,064 cubic feet per hour to 478,344 cubic feet! Prodigious! And the velocity; ye gods! If only one might once see a 4-inch pipe pouring out gas at such a rate!

This is what comes of trusting too much to formulæ. This gentleman never saw the bog into which his mathematics were leading him, until he fell into it. The whole of this theorizing comes down to a very small bit of practical truth. What is the good of computing gas deliveries in this style, when there lies concealed in your formula a quantity which if strained too far, makes nonsense of it all? Beside, the facts cannot be forced. As Professor Hele-Shaw has well shown, there is a point of velocity beyond which you can no more drive a fluid through a pipe than you can a ship through the sea. Practically, by "boosting" or pumping to a legitimate amount, it is quite possible, and may be convenient, to increase the carrying capacity of a gas main. The degree to which the driving pressure can be profitably raised depends upon several conditions, of which the practicable velocity of the stream of gas is not the least important. This varies with the size and length of the pipe, among other things; and when this limit is reached, if more gas is still wanted, there is no other means of getting it than by laying another or a larger main. For all practical purposes of gas supply, the index is the distant pressure. The gas manager has to watch his worst pressure points, and make his dispositions for keeping them at a safe figure. As the draught grows he can cope with it to a certain extent by raising the initial pressure, or sometimes, preferably, by interpolating a suction fan at an intermediate point; but not all the mathematical formulæ in the world will avail to help him beyond the limit of the physical factors in the problem, the value of which can only be ascertained by experiment. This is, of course, a truism; but we can see by what has been considered here how easily the truth may be lost to sight.

An Electric Pumping Plant in the Hawaiian Islands.

Electricity says it is interesting to note that the majority of the plantations in the Hawaiian Islands have installed pumping plants supplied by the Allis-Chalmers Company. The latest of these is the Makee Sugar Company, which is having erected a complete pumping outfit for an irrigation system.

The primary driver will consist of a specially designed impulse water wheel, operating under a fall of 400 feet of water conveyed in penstock pipes from a mountain stream and delivering its power continuously to a Bullock alternating current generator, direct connected, at six maximum speeds, which are secured by the use of six different sets of buckets arranged on wheels of varying diameters.

Mountain streams are not very numerous in the Hawaiian Islands and are usually comparatively inaccessible places, rendering it impossible to lead the water by means of flumes or ditching to the land to be irrigated. Furthermore, it is frequently the case that, while the quantity of water available is small, the head is comparatively great, thus enabling a large amount of horse power to be obtained. Under such conditions an electric generator driven by a water wheel may be installed at the falls and the power generated there transmitted to a distant pumping plant located but a few feet above sea level, which obtains its supply from wells or underground tunnels. At such points the quantity of water available is usually abundant. The fundamental

engineering problem is, therefore, to utilize a small quantity of water under a high head to raise a large quantity of water to a comparatively low head.

As the quantity of water in the mountain streams varies during the different seasons of the year, in order to get the full benefit from the amount available at any time it has been necessary to evolve a scheme by which the speed of the pump can be varied in proportion to the flow at the source of power.

The head being constant, the velocity of the water at the delivery nozzle is constant, and the horse power varies directly with the water supply. By changing the dimensions of the wheel carrying the buckets, the rotative speed of the generator is changed, while the speed of the water remains constant at all times. With constant field strength on the generator, the voltage will be directly proportional to the rotative speed, and as the cycles are also proportional to the rotative speed, it will be seen that the volts and cycles vary in a fixed ratio to each other.

The energy from the generator being delivered to an induction motor, the speed of the motor, and therefore of the pump, will change in the same proportion as the speed of the generator. As both the frequency and the voltage change in the same ratio, the induction motor will at all times be operating under conditions corresponding to those for which it has been designed.

The generator is rated at 300 kw., 3-phase, 60 cycles, and will have a normal speed of 450 revolutions per minute.

The pumping plant will be located 5 miles from the power station. Here is to be installed a Bullock induction motor of 225-horse power, and this, by means of rope transmission, will drive a duplex, double-acting Riedler pump, having a capacity, against 250 feet head (including friction), ranging from 1,750 gallons per minute, when the water wheel has 5 cubic feet per second supply of water, to 2,800 gallons per minute (4,032,000 gallons per 24 hours), with a supply of 8 cubic feet per second at the wheel. The speed of the pump, operated at its full capacity, will be 116 revolutions per minute. It is to be extra heavy, and furnished with Allis-Chalmers Company's latest improved mechanically operated pump valves.

The generator will have its exciter of 8 kw. direct connected to it, and the exciter has been so designed that it can deliver the full voltage and current required for excitation even at the minimum speed. By means of an automatic regulator the exciter voltage will be maintained constant at all speeds of rotation, and it will therefore be unnecessary to change the adjustment of the generator rheostat when the speed of rotation is changed. In addition to the automatic regulator a hand operated field regulator will be installed for use in an emergency. It was the original intention to use at the pumping station a synchronous motor, which would require a 50-horse power motor for starting, as well as an exciter, controllers and apparatus for throwing the starting motor in or out; but it was found that the system could be simplified by the use of an induction motor. The operation of the plant remains otherwise practically the same, and, of course, the induction motor requires neither a starting motor nor exciter but merely controlling apparatus. The efficiency of the whole plant will be the same with an induction motor as with a synchronous motor, while in simplicity of construction, reliability of operation, small amount of attention required, and also in the matter of first cost, the induction motor has the advantage. Necessary by-pass valves are provided for use in starting up. Either side of the pump may be run separately when desired.

Many Riedler pumps have been installed directly driven by water wheels. On account of its high rotative speed, this type of pump is especially adopted for electric drive. In many cases the power may be directly connected to the crank shaft of the pump. There are but few cases in which more than single reduction is required. Because of the high number of revolutions for a given capacity, less water is pumped per stroke, and as the strokes occur with greater frequency, the continuity of flow in both suction and discharge piping is kept up. The total work is thus more evenly distributed, severe shocks eliminated, and the strains on driving machinery made uniform and reduced to a minimum.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, Jan. 10th, 1906.

The Incandescent Mantle.—Where Does the Dividend Come From?—Cheap Gas is the Right Policy.

Probably the most important appliance with which gas engineers have to deal to-day is the incandescent mantle, which is displacing flat flames so rapidly that in a very few years it will represent the bulk of the lighting. The union jet and the batswing, if retained at all, will simply be used for special purposes to which the mantle is not conveniently adaptable. At the beginning of a new year we naturally take stock of our position, and the question of progress as regards the mantle is a very pertinent one. If we turn to our files of makers' catalogues we find that every large house in the trade makes a special brand, and that most of them make the best, the only unbreakable, the most endurable, and so on. According to the lists there is no such thing as a bad or a fragile article to be had, and where there are so many "bests" it is bewildering to know where to place the order. One is reminded of Artemus Ward's crack army, every man in which was so smart that he did not rank below a brigadier general. The practice of adopting silly, or at best meaningless titles, to which I have alluded on a previous occasion, still seems to find favor, and indeed is extended to include catch phrases intended to be of a humorous character. Yet one can scarcely conceive that a gas engineer is likely to favor an article because it is known by an idiotic name, or because the particulars of prices and discounts are sandwiched between sentences of the "Joe Miller" order. One does not like to go so far as to say that the only improvement in mantles has been in the art of setting forth their virtues, and inferentially concealing their defects. But there is a strong family likeness in all the various makes, and the so-called "improvements" run more in the direction of care in selection and in rejecting damaged ones than in any fundamental advancement in the manufacturing process. Of course, with experience, people become more used to handling and using them, and anyway the quality and cheapness of the light they afford is sufficient to enable incandescent gas lighting to hold a foremost place in the ranks of artificial illumination, and most gas undertakings are now running a maintenance department. As a consequence they are very large buyers and are interested in finding out what is really the best article on the market. Apart from the labor concerned in renewing mantles there is the possible inconvenience to the consumer and, therefore, the gas industry would welcome any improvement in quality to some extent regardless of cost.

We have experienced a month of very mild weather at a period of the year when something more severe is expected, and the sales of gas have suffered in consequence, so far as the use of gas fires is concerned. The sale of gas for heating is a popular cry amongst smoke abatement faddists and some others, but fluctuations such as the above set one wondering whether those who talk so loudly about gas for fuel have ever troubled to consider the subject in its practical bearings, such as the cost of production, the maintenance of a proper supply and the price at which it could be sold to give a fair and reasonable profit. Some undertakings are beginning to think about running a cheap, blue gas department for heat and power purposes, and it is well to recognize the fact that the practical conditions of demand are very different from those obtaining with what may be called, for the sake of distinction, ordinary yellow gas. The arrangements for the supply of the latter are based primarily and chiefly on the lighting demand, and a certain amount of day consumption has been tacked on to it, but the time of sunset and sunrise continues to control the gas engineers' calculations as to variation in demand as between one period of the year and another. The summer consumption has increased in a larger proportion than the winter, and the slack time is becoming smaller by degrees and beautifully less, but still the gas engineer regards December as his heaviest time, and feels that if he can tide over Christmas, he can face the remainder of the year with impunity. At present the heating business is not an important proportion of the whole, but it is sufficient to give some indication of the conditions that would prevail if it formed the bulk. Not only would the fluctuation as between summer and winter be more marked, but there would be large variations following the rise or fall of the thermometer, irrespective of hours of daylight or darkness. By a fortuitous coincidence there is some connection between the darkest and the coldest part of the year, but the example before us shows that it cannot always be depended on. Whether it would be possible under the usual conditions of manufacture, purification, storage and distribution to supply a cheap heating gas is a very doubtful question. There would be fluctuations in demand, not of 10 or 15 per cent. such as we are accustomed to, but very much larger, so large as to call for greatly extended storage, or for a more elastic manufacturing process. Something on the lines of the suction process, in which the production follows closely on the heels of the demand would appear to be needed. The purifying plant would need to be large enough to take care of the maximum rate of production. While there is no objection to a moderate proportion of gas fire business, it is evident that if heating was the mainstay of the demand there would be trouble in store for the management.

Every gas manager will do well to satisfy himself as to where the dividend comes from. Is it from the incandescent burners, from the cookers or from the gas fires? And if from all three, does one constitute more than another?

For the purposes of a rough comparison we may say that of the price per 1,000 cubic feet paid by the consumer, one-third goes for cost of

manufacture and storage, one-third for distribution and establishment expenses, and one-third for dividend on capital. Under ordinary circumstances the margin for a reduction in price cannot exceed 33⅓ per cent., and to get that we should have to make gas for nothing. A process reducing the cost of manufacture one-half would only mean a saving of 6d. per 1,000 cubic feet to the consumer. It may be assumed that distribution and interest have already been brought as low as practical conditions admit. A well managed concern may have some margin for future extension of business as regards the size of the main pipes, but it will not be an excessive one, and there is no reason for expecting to be able to supply a substantially larger quantity through the same distributing system. The same may be said in respect to establishment expenses. In some of the cheap processes recommended there is no adequate provision for purification, but although the consumer does not object to any amount of poison provided it is self administered, he (or his representatives) will not tolerate even a suspicion of sulphur in the gas supplied by a company. Apart from that as the cost of purification of coal gas is less than 1 penny per cubic foot, the item of purification is not worth laboring. It is easy to work out a grand scheme for supplying blue gas at 6d. per 1,000 cubic feet on paper, but in the light of actual existing conditions, as established by years of experience, it is difficult to see the practicability of selling at something less than the cost of one only, of the three items above mentioned. Increase of output enables a steady reduction on all of them to be effected, but that is a gradual process that does not jump 50 per cent. or so at a stretch. Some enthusiasts go so far as to say that existing gas companies cannot meet the demand for cheap fuel gas, but they fail to make it clear how anyone else can do so. The existing companies are not possessed of suicidal tendencies, and it may be taken that if any substantial improvement was forthcoming, they would hear of it as soon as anybody and would adopt it and have it in going order perhaps before the public knew of it. So there is no valid reason why some outsider should step forward and go one better than the established concerns. And any scheme of cheap heating gas must not only be manufactured for next to nothing, but must promise a large reduction in respect to capital investment as compared with the quantity sold and in the cost of distribution.

There is a great deal of talk at present about doing things on the magnificent scale. Gas and electricity are to be generated at the collieries and distributed to towns within a radius of 100 miles or so. But most of these schemes have not progressed further than the paper stage. The chief idea is to supply existing companies at a price cheaper than they can work for themselves. It is to be presumed that such an arrangement would take over all responsibilities in respect to purity or efficiency of supply. For one thing there is a large margin to work on because the railway freightage rates for coal are very heavy. In the case of companies 100 miles or more from the pits, the railway charges amount to as much as those of the colliery owner. They are much higher, I am told, than in other countries, and therefore if the generators in both schemes are capable of being worked at a success, they will have the best chance in England.

Meanwhile the policy to be followed by the present suppliers is obvious. It is the best article at the lowest possible price, and this scheme goes a great deal further than a mere cheese-paring economy in the expenditure. It represents much more than the mere lopping off of some superfluous items and reducing others. The best way to make gas cheap is to increase the sales, and, therefore, it may be that the efficient carrying out of the policy means a substantial increase of capital. There are very few districts that have been adequately canvassed, and where a substantial increase of business could not be had for the mere asking. The usual position of affairs is that the demand has a natural growth quite equal to the rate at which the company care to enlarge their plant and consequently their outlay, and, therefore, the manager who resorts to active canvassing may find that his promises in the shape of accepted orders have run a long way ahead of his power to fulfil them. Where a standstill policy is preferred rather than an increase of capital obligations, it invariably follows that increased sales are discouraged, and also that other competing agents are indirectly assisted, for there is no royal road to increasing business. Additions to manufacturing or distributing plant are not to be obtained without expenditure, and therefore, the first step is to arrange for the placing of a sufficient amount of stock at the most favorable rates. Many undertakings suffer by not recognizing this fact. Extensions are staved off until the prospective customer has arrived at the end of his patience, and says firmly that if he cannot have gas he will have something else. The result is that the extension is carried out forthwith, regardless of expense, and an issue of additional capital, on the same unbusinesslike lines, is necessary to meet the cost. After some years of this policy, small wonder if the capital outlay is found to be excessive, as compared with the actual structural value represented by it. By judicious foresight and issuing new stock or buying new plant when the market conditions are favorable, considerable economies may be affected.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. ABRAM SHIRE, for many years President of the Paris (Ky.) Gas Light Company, died at his home in that city the afternoon of the 17th inst. He was in his 76th year and was well known throughout the jewelry shops of the southwest.

A CORRESPONDENT in Davenport, Ia., writing under date of the 18th inst., says: "An important business change and one that promises much good for a 'Greater Oskaloosa' was announced a day or so ago —I presume you know Oskaloosa is in Iowa! The majority interests in the Oskaloosa Gas Company, formerly owned by Mr. W. E. Tyler, of Philadelphia, have been purchased by the Heald-Stevens Company, of Grand Rapids, Mich. A new local company, capitalized in $150,000, has been organized to operate the plant; and the corporate name thereof is that of the Oskaloosa Light and Fuel Company, whose owners promise much that is new and better than that which was old and not useful. The first improvement announced is an increase in the capacity of the water gas installation; following therein it is the intention of the owners to extend the main service, and then to remodel the office quarters, which have not been in the last few years either a source of comfort to the office force or a picture worth looking over by the patrons. The officers of the Company are: President, W. R. Lacey; Vice-President, W. T. Heald; Secretary and General Manager, William Bailey. The latter gentleman can safely be counted on to do in the future even better than he has done in the past.—F. R. M."

AT the annual meeting of the stockholders of the Flint (Mich.) Gas Company the following Directors were elected: W. H. Anderson, George Bardren, J. J. Carton, C. M. Begole, Claude Hamilton, C. B. Kelsey, W. C. Owell, R. W. Whaley, J. C. Wilson, Lewis H. Withey and B. C. Robinson.

AT the annual meeting of the shareholders of the Savannah (Ga.) Gas Company the officers elected were: President, Samuel T. Bodine; Vice-President, John W. Golden; Treasurer, L. Lillie; Assistant Treasurer, John W. Golden; Secretary, W. F. Douthirt.

WE are indebted to the courtesy of "N. W. F." for this personal account concerning the fraternal matter reported: "Mr. W. E. Mockett, who retires as General Manager of the Dallas (Tex.) Gas Company, February 1st, was given a pleasant surprise at his home, 205 Cadif street, Dallas, the evening of the 13th inst. The office force of the Gas Company visited his home in a body and presented him with a handsome gold watch fob, upon which was inscribed his monogram and the date of presentation. The spokesman of the party was Mr. J. P. Evans, who said in presenting the token: 'Mr. Mockett—We, your employees and subordinates for the past 3 years, learn of your resignation as our chief with feelings of regret not altogether removed from sorrow. In our appreciation of the courtesies which have always characterized your dealings with us and the goodwill always shown us when our interests have been in your hands, I am delegated to hand you this token of our esteem with our best wishes for your welfare and happiness.' Mr. Mockett's reply was: 'Gentlemen and Associate Employees—Indeed you have surprised me this evening, not from the expression made regarding your kindly feelings for me because I always have assured myself as existing as your countenance gave full evidence of its existence. The surprise came through you emphasizing your feelings by presenting me with this gift which will ever be dear to me and also will ever serve as a proof of your expressions, no matter what distance or time should intervene. I could talk at length regarding my appreciation of this gift and the many days of valuable service you have given the Company. Never have any of you been found wanting, but instead, you have given your employers full co-operation resulting in harmony and efficiency. Your interests and future welfare are dear to me and I wish you all continued success. If at any time I can serve you please command me.'"

MR. W. CLYDE HACKNEY has been appointed receiver of the Winfield (Kas.) Gas Company, with instructions to operate the plant, which was

shut down some months ago because of competition from a natural gas concern.

At the annual meeting of the shareholders in the Atlantic City (N. J.) Gas and Water Company the officers elected were: Directors, Savery Bradley, Jacob Disston, Thomas K. Reed, George A. Cotton, Michael A. Devine, A. Lowden Snowden, Wm. Disston, D. B. C. Catherwood and Joseph Thompson; President, Savery Bradley; Vice-President, Jacob Disston; Treasurer, Thomas K. Reed; Secretary and Manager, John P. Tompkins.

A correspondent in Manchester, N. H., incloses the following: "At the annual meeting of the Peoples Gas Light Company, of this city, Mr. Arthur N. Heard was elected President, succeeding the late Mr. Frank Dowst. Mr. Heard had been elected to the Board of Directors upon the death of Maj. J. F. Briggs, and his advance to the Presidency of the Company left a vacancy on the Board, which was filled by the choice of D. D. Felton. The full staff of officers and Directors elected is as follows: President, Arthur N. Heard; Vice-President and Clerk, Alonzo Elliot; Treasurer and Superintendent, Walter G. Africa; Directors, A. N. Heard, Alonzo Elliot, W. G. Africa, Walter M. Parker, D. D. Felton and E. L. Brundrett."

The new water gas plant of the Deadwood (S. D.) Gas Light and Fuel Company is in satisfactory operation. The cost of the installation was $20,000.

At the annual meeting of the Willimantic (Conn.) Gas and Electric Light Company the Directors chosen were: Messrs. George A. Lewis, D. Tilley, C. H. Evans, J. F. Church and C. W. Noyes.

"W. C. T.," writing from Akron, O., says that Messrs. Henry Robinson, John Macgregor and W. E. Steinwedell, named as appraisers of the properties of the Akron (O.) Gas Company, under the application of Receiver A. B. Eilbeck, are about ready to submit their report.

The first annual meeting of the National Commercial Gas Association, under the Presidency of Mr. William J. Clark, was held in the Hotel Cadillac, New York, the 24th and 25th insts. The meeting was a very successful one, the attendance being much better than had been counted upon. The papers that seemed to attract the most attention were these: "New Business Methods: A Query: What Are the Best to Employ?" by Mr. J. D. Shattuck, of Chester, Pa.; "The Gas Range in the Kitchen," by Arthur H. Elliot, Ph.D., of New York; and "The Relations of the Gas Man and the Gas Appliance Man to the Gas Industry," by Mr. R. M. Searle, Mount Vernon, N. Y. The social features were well and sensibly carried out. Mr. Clark made an excellent President.

The annual meeting of the Washington (D. C.) Gas Light Company will be held at noon of the 5th prox.

The selling rate at Hastings, Neb., now rules at $1.90. It was $2.25.

At the annual meeting of the Hartford City (Conn.) Gas Light Company the following officers were elected: Directors, Ed. B. Bennett, S. C. Dunham, James H. Knight, George Roberts, John R. Hills, F. R. Cooley, S. R. Bertron, R. S. Storrs and Jno. T. Robinson; President, E. B. Bennett; Vice-President, S. R. Bertron; Secretary, John A. McArthur; Treasurer and General Manager, R. E. Slade.

Mr. W. E. Barrett, of Scranton, Pa., writing from that city under date of January 23d, says:

To the Editors American Gas Light Journal: I have read with some interest Mr. Cole's article, in your issue of January 22d, entitled "Electrolytic Action and Gas Mains." While I agree with his theory, to a certain extent, in relation to the conductivity of the bodies and the proportional areas of the cross sections, at the same time I cannot but feel that the argument is not strong wherein it states that generally the gas engineer, or, to quote exactly, "That gas engineers are to a large extent somewhat hazy on the subject of electrical resistance." The effect of electrolytic action has become so important a factor in the past 20 years, that the gas engineer has been driven by that first law of nature, "self-preservation," to protect himself and his industry, that a very careful study has been made of electrical subjects, and especially has this demand grown upon him, where the changed condition of affairs has caused a uniting of the of the gas and electrical industries, and this study has undoubtedly brought out to a much greater degree the importance of this subject. Further, the argument assumes certain conditions, which, from a theoretical standpoint, might be fair, and we are agreed that the practical conditions must derive their accuracy from an originally correct theory, yet the practical side of this subject cannot be ignored in any of its phases, while we are arriving at correct theories as to possible cause and protection. It certainly cannot be Mr. Cole's idea to relieve the cheap and badly constructed street railway of the responsibility for its negligence, and the attempt to make a large earning on a small investment, by requiring gas, water, telephone and similar quasi-public serving corporations occupying public property to contribute to this earning of the railways, by assuming the expensive repairs made necessary by the escaping current from the street railway lines. Apparently the ground he takes is that the street railway has an impregnable position, both as to responsibility and the correctness of the manner of construction, and that it is strictly up to the other fellow to care for himself and provide his own protection as best he can. Was it ever known that a gas company was not held responsible for the killing of trees along its lines? Even though the leak was a very small one. Certainly, Mr. Cole would agree that the responsibility for the cause of this destruction was properly placed. How, then, can he propose to relieve the street railway company from the same position? The moral bond of the responsibility upon the street railway company is a very intangible condition, but the only one of respect is the legal one, and this only in proportion to the vigor of its application. It is quite well understood among gas engin ers that street railway companies do not apparently depend upon the subterranean fixtures of other public serving corporations to provide a part of their system of construction, but the right is not endowed upon either to negligently destroy the property or any part of it by the other. The position seems to be one that it is sufficient the street railway has provided a metallic return for its current, regardless of the manner of construction and efficiency; and, behind this fact, refuge is taken as to the full performance of the part of the street railway, and that others must needlessly increase investment and operating expense in consequence. Upon this line, as I have construed the article, the street railway construction has reached practical perfection (?) and, therefore, there is nothing left but to put the burden of expense on the other fellow. Who shall attempt to say that, in the course of a few years, our present systems of street railway construction will not appear crude and wasteful? Is there any good and substantial reason, beyond commercialism, that prevents the employment of a properly protected return by the street railways? The theory that pipe systems collect their electricity over large areas and discharge it in positive districts has undoubted merits, yet it must be acknowledged that present methods of construction and the use of bonded rail returns have been adhered to because of the simplicity of form and the economy of construction; also that this method has answered the purpose fairly well from the street railway point of view; but there is no well founded reason why, if this system of return is to be adhered to and continued, that reasonable methods of insulation or protection of the rails from this source of leakage should not be provided by the street railway, or the system changed to such form that will not subject others to the needless expense and trouble of using insulating joints or similar means of high resistance. The local conditions vary so widely that it is not possible to fix a set rule for the number of insulating joints per mile of pipe, and the use of such joints should be discouraged as far as possible, as not having the requisite of the usual substantiability practiced in the gas industry. An insulating joint at best can be nothing more than a makeshift, and in any line of business such a policy should be discountenanced. The question naturally returns to the ounce of prevention, and if the railway is constructed with this idea in view as well as others, and the effort made to produce well designed, substantial workmanship, instead of "how cheap," the result will not only be a relief from the complaint of electrolytic destruction, but will show a good return in lessening the item of maintenance and repairs to the railway companies.

At the annual meeting of the Winsted (Conn.) Gas Company the officers elected were: Directors, J. R. Griswold, F. M. Travis, H. Gay, Rufus E. Holmes, Henry Skinner, M. H. Tanner and E. B. Parsons; President, R. E. Holmes; Treasurer and Manager, H. Skinner; Secretary, F. M. Travis.

Mr. C. F. Cattell, Superintendent of the Chester County (Pa.) Gas Company, has added a real Bergonizi violin to his already extensive collection.

The business of the Woburn (Mass.) Gas Company has gotten to the point where Superintendent Gilcreast is ready to speak to his directors.

The Market for Gas Securities.

The market for city gas securities is much more animated than it had been for several weeks. The gain in bid price for Consolidated for the week is about 8 points, even considering the dividend for the last quarter of 2 per cent. on. The queer things at the annual meeting were the electing of Mr. A. H. Elliott to a trusteeship, vice Mr. G. H. Church, resigned. The other trustees were re-elected, as were the former executive officers, and no President was elected. No reports were submitted. The state of affairs in Irving Place is, to say the least, queer.

Brooklyn Union is bid 170 to 180, and we have it on fair authority that it will be 200 before February 1st. Washington (D. C.) keeps climbing, and it will go higher. Peoples, of Chicago, is a purchase at the quoted figures.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JANUARY 29.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	180	180½
Central Union, Bonds, 5's	3,000,000	1,000	108	110
Equitable Bonds, 6's	1,000,000	1,000	..	105
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	275	290
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	107	109
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	98	104
Northern Union, Bonds, 5's	1,250,000	1,000	105	107
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106½	108½
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	114
Yonkers	299.650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	170	180
" " Bonds (5's)	15 000,000	1,000	112	113
Bay State	50,000,000	50	⅜	..
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000.000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	10	12
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106¾
Cincinnati Gas and Electric Co	22,500,000	100	106½	106¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,026,500	100	107½	108
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	84½	85
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
" Bonds, 5's	10,500,000	..	110	110½
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	.	..
Preferred	2,500,000	100	100	105
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind	1,000,000	100	..	60
Bonds	1 000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	100	100½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104½	105½
San Francisco, Cal	15,800,000	100	58½	58¾
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,600,000	20	303¾	305
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4 000.000	..	..	..
Wilmington, Del	600.000	50	230	..

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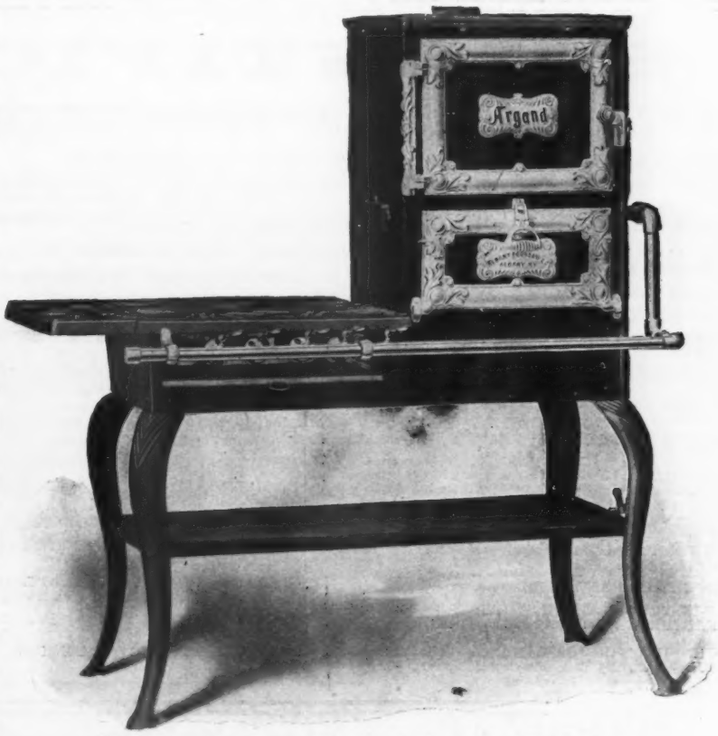

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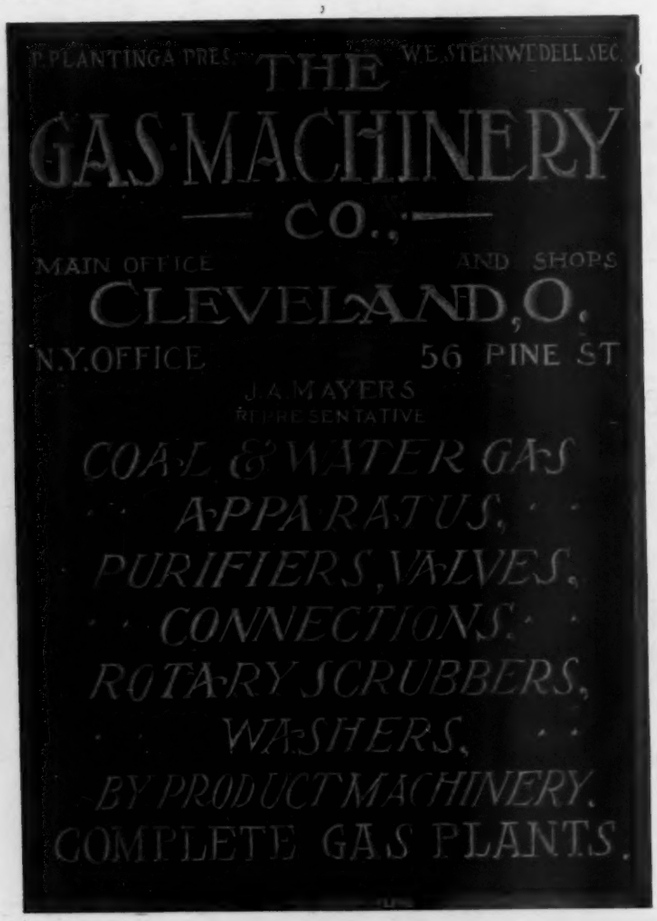

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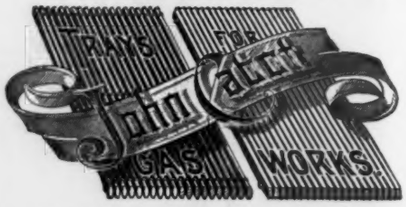

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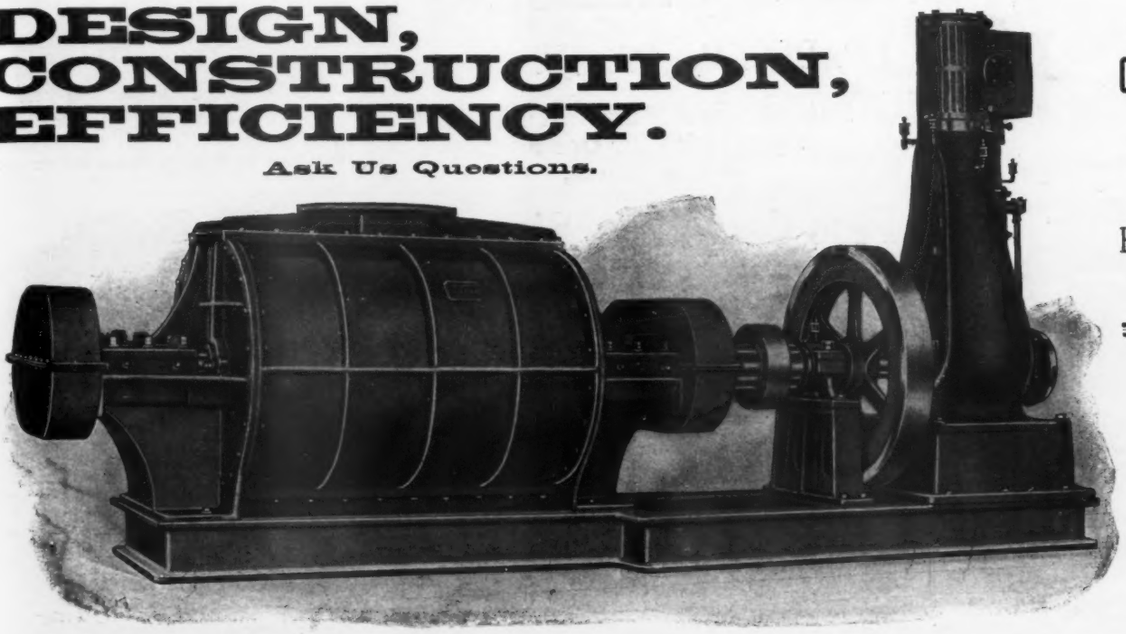

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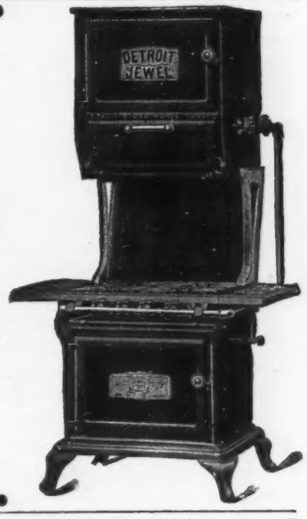

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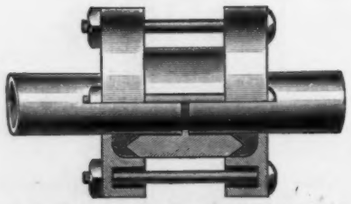
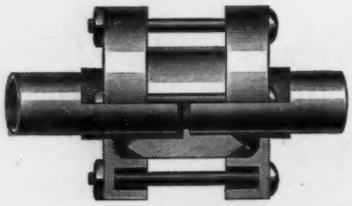
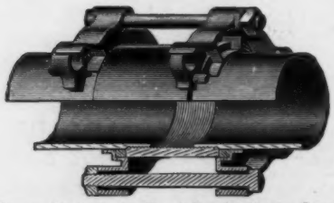


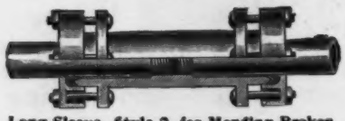
Regular Coupling, Style 1, for Plain End Wrought Iron Pipe.



Insulating Coupling, Style 5, for Plain End Wrought Iron Pipe.



Clamp, Style 4, for Repairing Leaks on Screw Collar.



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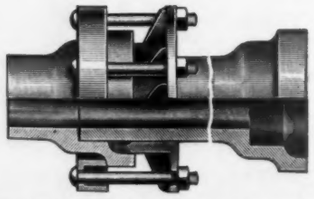
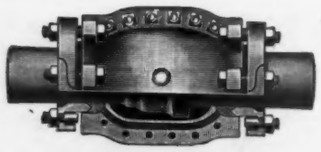
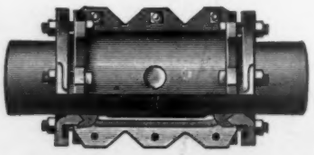


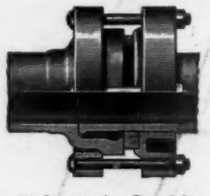
Coupling, Style 9, for Special Style Cast Iron Pipe.



Split Sleeve for Repairing Broken Bell on Cast Iron Pipe.



Split Sleeve for Repairing Broken or Cracked Cast Iron Pipe.



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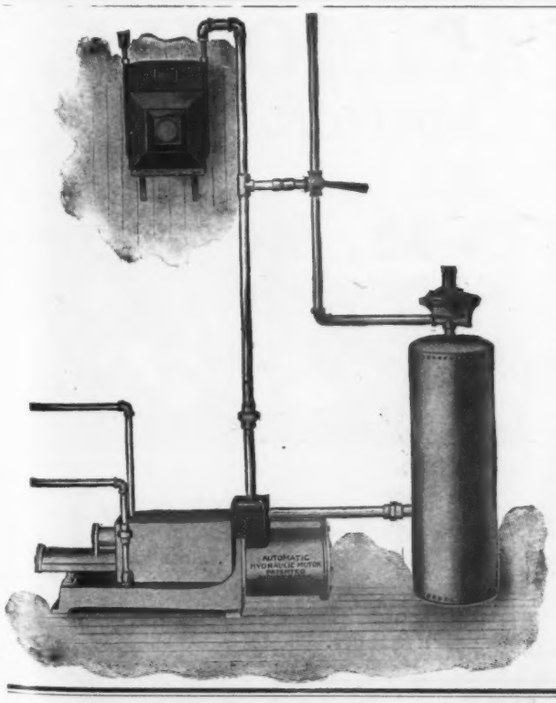

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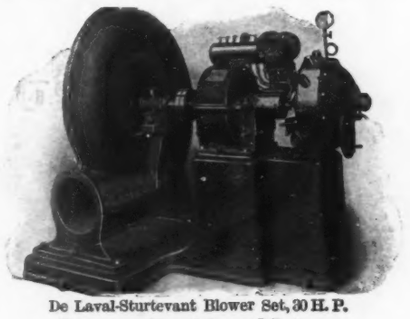

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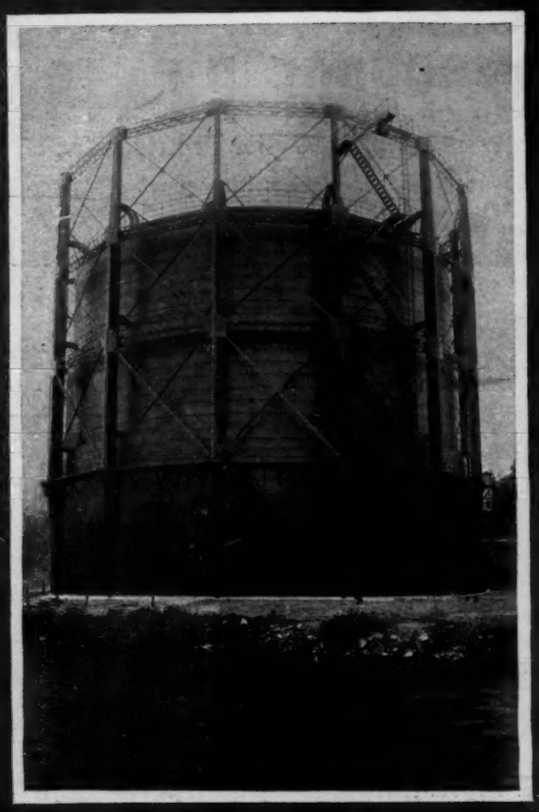

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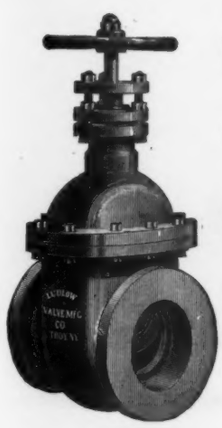

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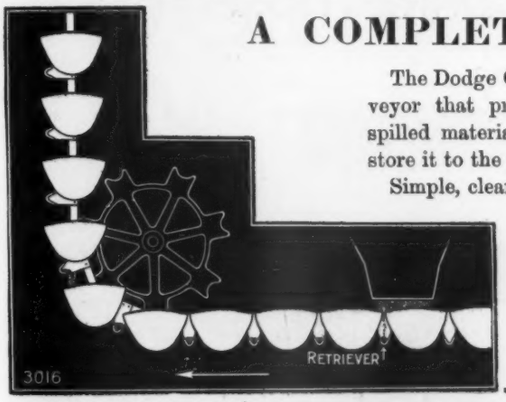

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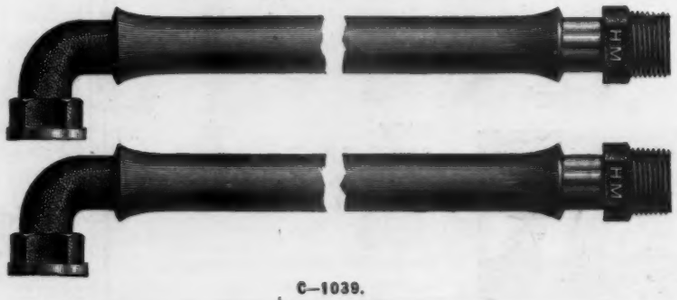

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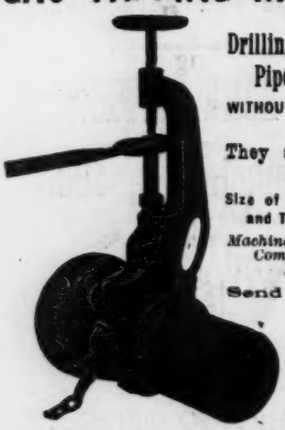

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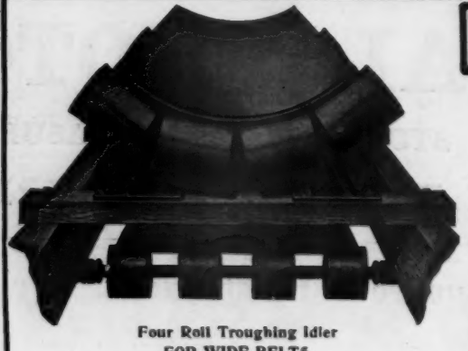

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FEBRUARY, 1906.

Table No. 1.
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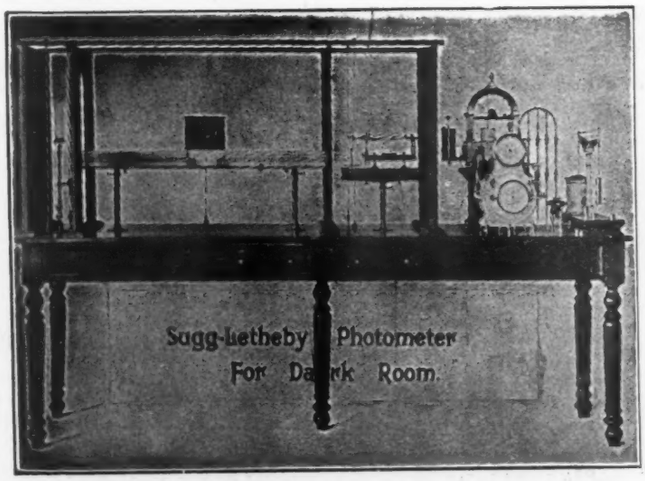
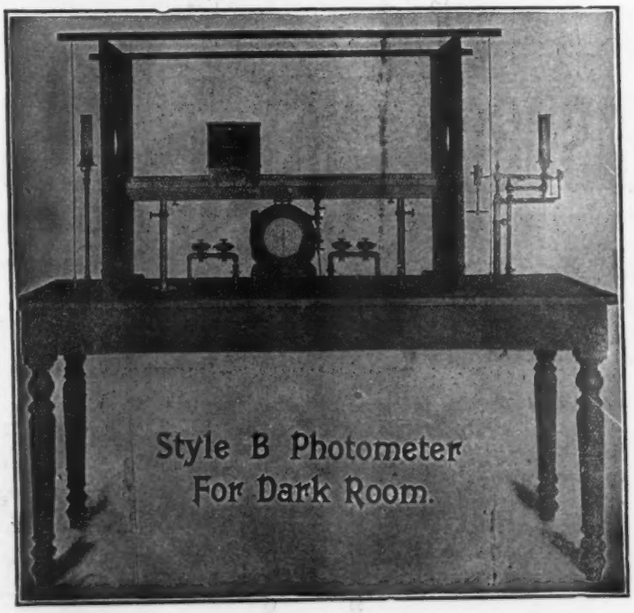
Day of Week.	Date.	Light.	Extinguish.
Thu.	1	12.20 AM FQ	6.10 AM
Fri.	2	1.10	6.10
Sat.	3	2.10	6.10
Sun.	4	3.00	6.10
Mon.	5	3.50	6.10
Tue.	6	4.40	6.10
Wed.	7	No L.	No L.
Thu.	8	No L. FM	No L.
Fri.	9	No L.	No L.
Sat.	10	6.00 PM	8.10 PM
Sun.	11	6.00	9.20
Mon.	12	6.00	10.30
Tue.	13	6.00	11.40
Wed.	14	6.00	12.50 AM
Thu.	15	6.00 LQ	1.50
Fri.	16	6.00	3.00
Sat.	17	6.00	4.00
Sun.	18	6.10	5.00
Mon.	19	6.10	5.50
Tue.	20	6.10	5.50
Wed.	21	6.10	5.50
Thu.	22	6.10 NM	5.50
Fri.	23	6.10	5.50
Sat.	24	6.10	5.50
Sun.	25	6.20	5.40
Mon.	26	6.20	5.40
Tue.	27	9.10	5.40
Wed.	28	10.10	5.40

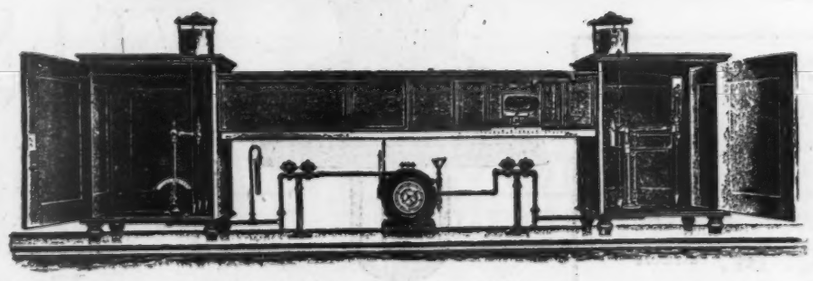
TOTAL HOURS DURING 1906.

By Table No. 1.

	Hrs.Min.
January	223.40
February	190.40
March	192.10
April	167.00
May	152.20
June	142.10
July	150.20
August	157.40
September	170.00
October	185.10
November	201.40
December	214.00
Total, yr.	2146.50







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1906.

Table No. 2.
NEW YORK CITY.
ALL NIGHT LIGHTING.

Day of Week.	Date.	Light.	Extinguish.
		A.M.	P.M.
Thu.	1	5.05	6.15
Fri.	2	5.05	6.15
Sat.	3	5.05	6.15
Sun.	4	5.05	6.15
Mon.	5	5.10	6.10
Tue.	6	5.10	6.10
Wed.	7	5.10	6.10
Thu.	8	5.10	6.10
Fri.	9	5.10	6.10
Sat.	10	5.10	6.10
Sun.	11	5.10	6.10
Mon.	12	5.20	5.55
Tue.	13	5.20	5.55
Wed.	14	5.20	5.55
Thu.	15	5.20	5.55
Fri.	16	5.20	5.55
Sat.	17	5.20	5.55
Sun.	18	5.20	5 55
Mon.	19	5.30	5.55
Tue.	20	5.30	5.55
Wed.	21	5.30	5.55
Thu.	22	5.30	5.55
Fri.	23	5.30	5.55
Sat.	24	5.30	5.55
Sun.	25	5.30	5.55
Mon.	26	5.30	5.45
Tue.	27	5.30	5.45
Wed.	28	5.30	5.45

TOTAL HOURS DURING 1906.

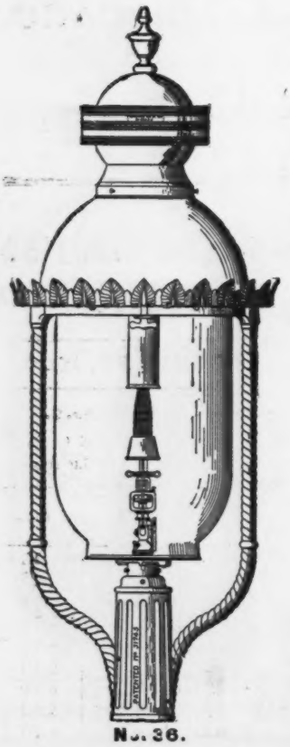
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street. BOSTON, 820 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, 218 La Salle Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

The Welsbach No. 6 Harp Fixture.

AN IDEAL LIGHT FOR DINING OR LIVING ROOMS.

THE HIGHEST MECHANICAL INGENUITY COMBINED WITH ORNAMENTAL BEAUTY--THE NEWEST OUTPUT FROM THE WELSBACH FACTORIES.

Equipped with new model No. 66 high candle power Welsbach Burner.

Side Pilot By-pass Tube covered with refractory sleeve to prevent bending.

Fourteen-inch Opal Dome Shade.

Polished Brass Embossed Crown 2¼ inches high.

Length of Fixture, 30 inches.

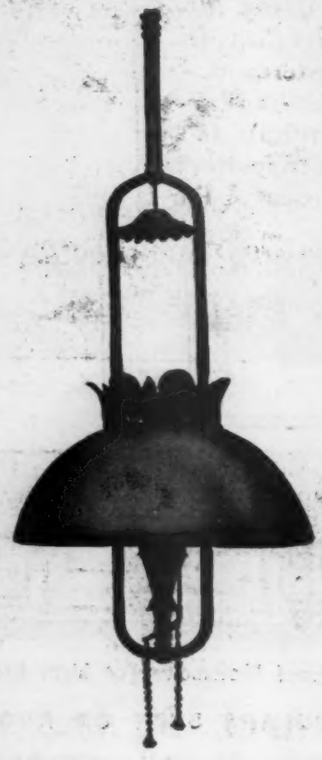
Width of Harp, 4½ inches.

Finished in Polished Brass.

Packed One Dozen to the Case.

List Price, per Dozen, $45.00.

We recommend equipping the No. 6 Harp Fixture with No. 4197 Intensive Brand Mantle, and the No. 306 **F. Q. M.** Clear Glass Air-Hole Cylinder.



Although the 14-inch Opal Dome Shade is standard equipment, we are prepared to furnish Dome Shades in green, pink or yellow (opal lined), and will be glad to quote prices.

WELSBACH CO.,

Salesrooms in all the principal cities of the United States.

Factories:

GLOUCESTER, N. J.

CHICAGO, ILL.

THE UNITED GAS IMPROVEMENT COMPANY

For the Year Ending December 31st, 1905, has been Awarded Contracts for 40 Sets of

Standard Double-Superheater Lowe Water Gas Apparatus.

PARTIAL LIST OF PLACES:

Catasauqua, Pa.
Plattsmouth, Neb.
Detroit, Mich. (2d contract).
Springfield, Ills.
Oneonta, N. Y. (2d contract).
Pottsville, Pa. (2d contract).
Evansville, Ind. (2d contract).
Lansdale, Pa.
Hempstead, N. Y. (2d contract).
New Britain, Conn.
New York, Mutual Co. (3d contract)
St. Louis, Mo. (4th contract).
Sioux City, Ia. (3d contract).
Amsterdam, N. Y.
Houston, Tex. (2d contract).
Hamilton, O. (2d contract).
Indianapolis, Ind. (2d contract).
Nanticoke, Pa.
Hazleton, Pa.
Mahanoy City, Pa.
Ludington, Mich.
Ossining, N. Y.
Lancaster, Pa.
Flushing, N. Y. (2d contract).
South Bend, Ind.
Fall River, Mass. (2d contract).
Minneapolis, Minn. (2d contract).

TOTAL SETS TO DECEMBER 31, 1905, ... 593
TOTAL DAILY CAPACITY TO DECEMBER 31, 1905, 463,780,000 CU. FT.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas. H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

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CLAY GAS RETORTS, FIRE CLAY TILES, FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
88 VAN DYKE ST., BROOKLYN, N. Y.
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CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

ST. LOUIS GAS CONSTRUCTION CO.,

DESIGNERS AND BUILDERS OF

COAL GAS BENCHES,

SPECIAL HIGH GRADE REFRACTORY MATERIAL FOR BENCH SETTINGS AND WATER GAS LININGS.

SOLE AGENTS FOR

CHRISTY SETTINGS.

CORRESPONDENCE SOLICITED.

ST. LOUIS, MO.

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An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 36th year of publication. Compiled and arranged by JOHN W. FIELD, Sec'y and Gen. Mgr. of The Gas Light and Coke Company, London. Price, $5. For Sale by

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Adam Weber Sons.

Manhattan Fire Brick and Enameled Fire Clay Retort Works.

Works at Weber, on the Raritan River, Middlesex County, New Jersey.

GENERAL OFFICES:
Park Row Building, New York City.

Modern Coal Gas Benches,

With either Horizontal or Inclined Retorts, Half-Depth and Full-Depth Recuperative Furnaces.

ADAM WEBER PATENTS

STANDARD BENCH IRONWORK.

Linings for Water Gas Apparatus, High Grade Fire Brick of All Shapes and Sizes, Ground Fire Clay, Ground Fire Brick in Bulk or in Barrels.

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Works, LOCKPORT STATION, PA.

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Successor to WILLIAM GARDNER & SON.

PETER YOUNG, Secretary and Treas.
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HENRY MAURER & SON,

(ESTABLISHED 1856.)

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RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD,
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NATIONAL PYROGRANIT COMPANY,

MANUFACTURERS OF

Fire Brick, Tiles, Special Shapes, etc.

NEW YORK OFFICE:
17 Battery Place, New York.

WORKS:
South River, N. J.

ESTABLISHED 1868.

L. N. RANCKE, Vice-Pres. & Mgr. F. SCHIAFFINO, Sec'y & Treas.

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BALTIMORE, MD.,

Manufacturers of all Material for the Construction of Coal Gas Benches.

HALF AND FULL DEPTH AND FREE FIRING BENCHES,

All styles of which we have in operation, equipped with the BEST of LATEST IMPROVEMENTS, proving our claim for SUPERIOR QUALITY and EFFICIENCY.

INCLINES—We have in SUCCESSFUL OPERATION benches of Inclined Retorts, MANUFACTURED and ERECTED by us.

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Agents for New England States.

LARGE FACILITIES—Correspondence Solicited.
RAIL and WATER CONNECTIONS to ALL POINTS.

JOHN DELL,
President and General Manager.

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ESTABLISHED 1882.

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Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** **The Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* **One** *to* **Six Retorts.**

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

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Three-Scoop and Three-Rake Charging and Discharging Machines are operating in New York, Newark, N. J., Philadelphia, Worcester, Mass., Mt. Vernon, N. Y., Toronto and Montreal, Canada.

Four-Scoop and Four-Rake Charging and Discharging Machines are operating in Detroit, Mich.

These are the only machines that will draw or charge simultaneously 3 or 4 retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

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COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

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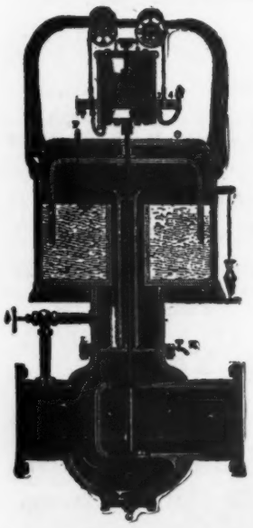

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COAL OR WATER GAS PLANTS,

Automatic, Balance, High Pressure and Service Governors,

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Iron Sponge, Purifying Material for Gas Purification, Jones Jet Photometers, Pressure Registers, etc.,

INSTALLATION OF SMOKELESS TAR BURNING SYSTEM,

Reinforced Concrete Construction for all Purposes.

Wide Experience in High Pressure Installation and Extension,

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Half and Full Depth Benches of Our Own Design, Containing 6, 8 or 9 Retorts.

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We Build Benches Complete. Ready for Gas Making. Also,

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STRICTLY High Grade. . . . .
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FOR COAL AND ASH HANDLING
IS NOT IMPAIRED WHEN.....
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Special High Grade Material for Recuperative Furnaces.
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THE SUN OIL CO.

Gas Oil, Gas Naphtha,
Refined Oil, Lubricating Oils.

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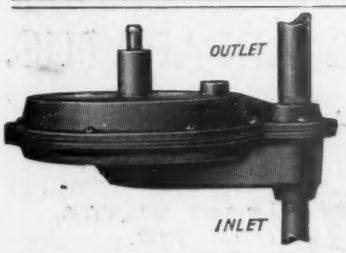

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Our Governors Reduce 30 or 40 Pounds Pressure to 2 Inches Water Pressure.

WE MAKE ALL SIZES OF

DOUBLE DISTRICT GOVERNORS, INDIVIDUAL HOUSE SERVICE AND LOW PRESSURE GOVERNORS.

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With Instructions for Care and Working of the Same,

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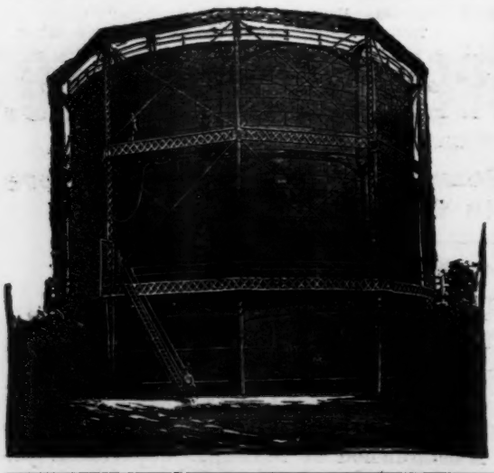

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Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

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SINGLE AND DOUBLE-LIFT GASHOLDERS AND STEEL TANKS,

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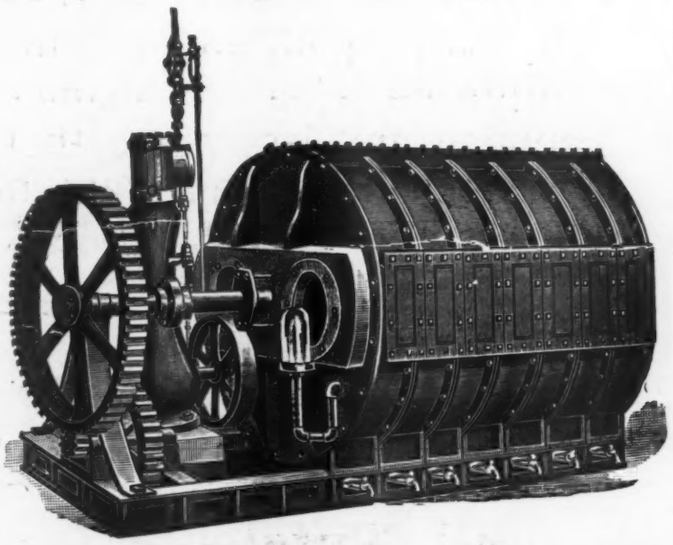
Designers and Builders of Gas Works.



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The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Disks, thus reducing the weight on shaft and power for operating same.

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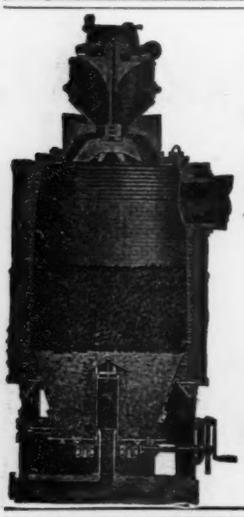
PROPERTIES PURCHASED.



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Size.	8 Inches.	10 Inches.	12 Inches	16 Inches.	20 Inches.	24 Inches	30 Inches.	36 Inches.
Diameter of flanges.....	13 inches	16 inches.	18 inches	22½ inches.	27 inches.	3 inches.	3[illegible]½ inches	44 inches.
Face to face of flange...	12 inches.	12 inches.	12 inches	14 inches	17 inches	20 inches	21 inches.	23½ inches.

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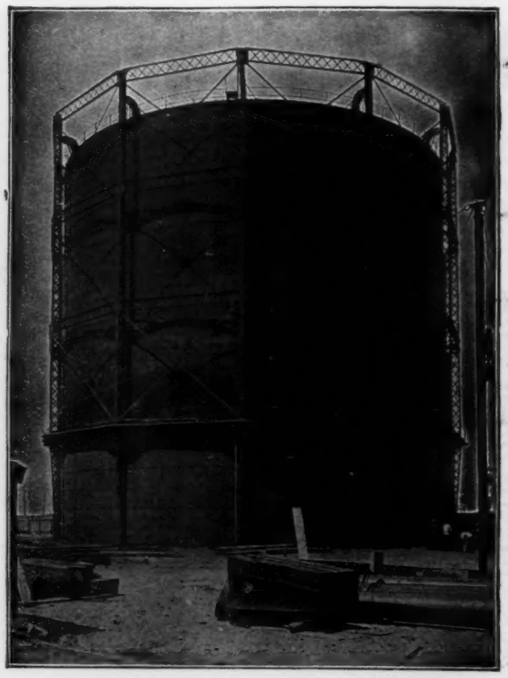

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EXCERPTS FROM DECISIONS

—OF THE—

BOARD OF GAS COMMISSIONERS of the COMMONWEALTH OF MASSACHUSETTS.

MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir: I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners, with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

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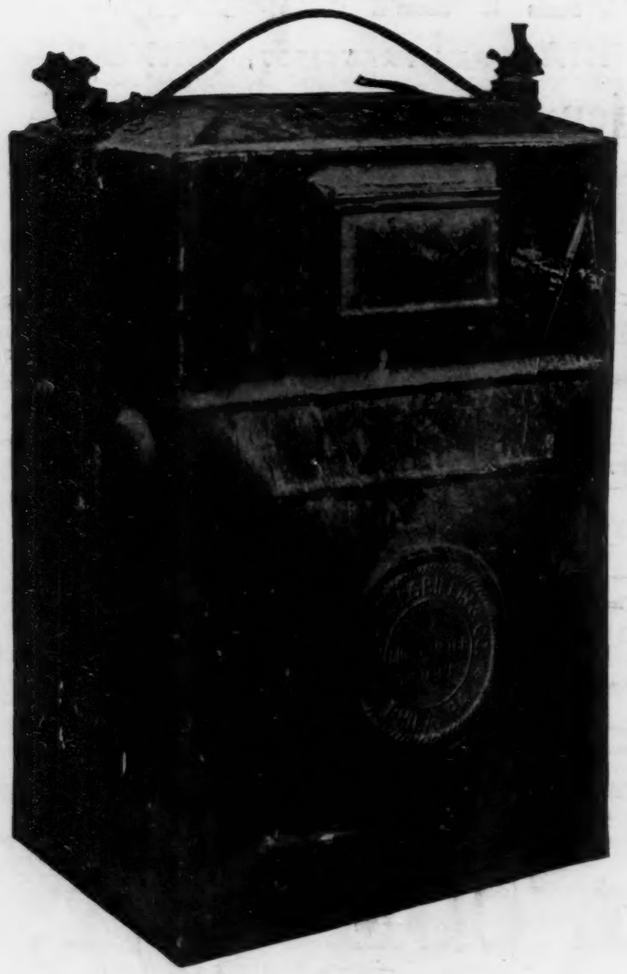

This is a photograph of a 3-light regular meter out of a lot of meters received from the Coatesville Gas Co., Coatesville, Pa., to be repaired and converted into prepayment meters.

AFTER.

This is the same meter after it has been repaired and converted into a new prepayment meter.

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